THE

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	Page
The Registration and Remuneration of Wiremen	41
Trade Unions and the Unemployed	42
Discriminating Relays and Cut-Outs (*illus.*)	43
Electrical-Law and Cases in 1904	46
Correspondence	48
Three-Phase Electric Haulage Plant at Shirebrook Colliery ...	53
Legal	53
Business Notes	54
Electric Tramways in Hong Kong (*illus.*)	57
The Metropolitan Railway Electrification (*illus.*)	60
Electricity Supply Accounts	71
City Notes	72
Stocks and Shares	72
Share List of Electrical Companies	73
Market Quotations	74
Electric Tramway and Railway Traffic Returns	74
The Electra Steam Turbine (*illus.*)	75
Our Legal Query Column	76
Institution of Electrical Engineers:—	
Stand-by Charges and Motor Load Development (*illus.*) ...	76
Electric Driving of Textile Mills (*illus.*)	78
New Patents Applied For	79
Published Specifications	80

THE

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THE REGISTRATION AND REMUNERATION OF WIREMEN.

AT a meeting of the Electrical Contractors' Association, held on the 10th inst., a short paper was read by Mr. Frank Suter on "The Workman and his Wages." The object of the paper was to advocate that "all workmen employed in the electrical business should pass a technical and practical examination." By "electrical business," the author obviously referred only to that part of the electrical industry known as contracting. In advocating a wireman's examination, he mentioned the fact that the artisans in other trades, including plumbers, had to pass examinations. The letters "R.P." after a man's name indicate that he is a registered plumber, and are a sort of guarantee that the man knows his business. It was not suggested in the paper referred to that a wireman who passed the proposed examination should write "R.W." after his name, but some system of registration was apparently aimed at.

The author's proposal was that "A committee be appointed to draw up examination papers in different grades for our workmen to pass;" and that those who passed such examination should receive higher wages than others who could not, or would not.

It is a committee of the Contractors' Association, then, that is to be the examining body. It would be a pertinent question for a wireman to ask, "And what are the qualifications of my examiners?" According to Mr. Suter, "We who pay trade union wages and have educated and thoroughly taught our men their business, have to compete with bell-hangers, builders, decorators, paper-hangers, &c." But these people style themselves "electrical contractors," and many of them have probably passed trade examinations. Examination papers set for the building trades contain questions on electrical work, it being recognised that electrical wiring is, or may become, a branch of the building trade, and before long, if it is not already the case, electrical questions may be included in the plumbers' examination also.

It is possible, then, that many of these trade rivals and competitors are really more fitted to carry out electrical work than some self-styled electrical contractors, whose only qualification is that they have held a ladder for a wireman, or have worked as labourers on a building in which electric bells have been fitted. One of the objects of the Contractors' Association is, we believe, to try to weed out these undesirable aliens, but in the present state of the contracting business it is doubtful whether a wireman, who really knew his work, would attach any importance to a certificate issued by any association of contractors, when the only contractors he knew would themselves fail to pass the simplest test.

The facts are that while there already exists a Wireman's Examination, viz., the City and Guilds Institute Preliminary and Practical Examination in Electric Lighting, the contractor himself need have no qualifications whatever.

D

It is somewhat inconsistent of Mr. Suter to look upon it as a virtue that he pays the trade union rate of wages, and yet maintain that "a good mechanic is worth three duffers." Trade unionism never taught him this. His own experience is absolutely opposed to the trade unionist idea, for, in his paper, the author says: "A skilled workman saves the employer in many ways. He is more careful in the planning of his work. He is less wasteful, and the more he understands his business, the better for the contractor. He has a knowledge of the amount and the size of the material he will require for his work, he is not always sending to your stores for material; when asking for fittings he will not forget screws, holders, blocks, &c. He requires less supervision, and enables you to look for other work, and at the same time feel that the work you are responsible for is being carried out to the specification."

And the man who does all this is paid the trade union rate of wages, the same as "the duffer!"

Here is a man who, to all intents and purposes, holds his employer's reputation in his hands; it rests with him whether the work pays or not, and whether or not it complies with the specification. It is he who really maps out the installation and carries it through. The contractor secures the contract, but *he* does the thinking. He takes his trade union rate of pay—sometimes; and the contractor takes the profit. Well might the author exclaim to his hearers, "You know to your cost that the average wireman does not think. Why should he? You have never made it worth his while."

And it is now proposed to make it worth his while by offering higher wages to the man who passes an examination. Now, a man may pass twenty examinations and still not have the qualifications enumerated above—qualifications which may be summed up as the ability to carry a job through satisfactorily and profitably.

If, as the author says, the employer has no time to "do the thinking;" if he "has enough to think about in obtaining the work;" then surely he should adequately remunerate the man who does the thinking for him.

Electrical contractors are, generally speaking, opposed to any bonus system of payment, although such systems have been tried with some measure of success; but the payment of a uniform maximum wage to all who pass an examination, and a less wage to others, will, whilst tending to raise the general standard of wiremen, not offer any advantage to the man who thinks.

TRADE UNIONS AND THE UNEMPLOYED.

The report of the Conference of representatives of the leading trade unions, which was convened for the purpose of considering the unemployed problem, was recently published. In view of the fact that the Conference included amongst its members many labour members of Parliament, and all the more prominent labour leaders, the report may be taken to voice the opinion of trade unionism. It is a pretentious and, to our mind, an ominous document. Pretentious, because it affects to explain, in a few words, the cause of unemployment; ominous, because in prescribing for the relief of those who are out of work, the trade unionists take the opportunity of showing us that it is still their policy to oppose any industrial development which, from their somewhat narrow point of view, may lead to the employment of fewer workmen. Some of the proposals are so ludicrous that they hardly deserve notice; but as the conference purports to speak on behalf of "labour," it may be as well to listen to some arguments on the other side.

The preamble to the Report is couched in the following terms:—

1. Preamble.—That this conference is of opinion that the main cause which leads to large numbers of men being without employment is due to the absence of organisation in industry, intensified by the increased introduction of labour-saving appliances unaccompanied by an adequate reduction of the hours of labour or a sufficient increase in remuneration; the displacement of men by women and young persons through the introduction of automatic machinery; the absence, particularly in Government works, of any attempt to regulate the distribution of work so as to maintain employment at an even level, thereby causing alternate periods of rush and stagnation; the fact that the financial resources of the country are being constantly drained in avoidable wars and extravagant expenditure.

It is not altogether clear what is meant by the "organisation in industry," the alleged absence of which is said to be the cause of large numbers of men being out of work. Inasmuch as the report comes from trade unionists, we can only assume that they are deploring the fact that, in spite of all their efforts, the trade unions are not sufficiently powerful. As they do not seem to be confident that this is the sole reason why workmen are out of employment, the members of the Conference fall back upon their old protest against labour-saving machinery; complain of the employment of women and young persons, and make the bold assumption that it is the duty of the Government to so regulate the distribution of work that there should no longer be alternating periods of prosperity and slackness in any (?) trade. The whole tenor of this preamble is extraordinary, when we consider that it has the sanction of all the influential leaders of labour.

The second paragraph of the Report makes the sweeping assertion that all the existing methods of relieving the unemployed are defective and inadequate, if not positively harmful; and in paragraphs 3 and 4 the Conference makes proposals which, we presume, it considers to be all-sufficient.

It is here suggested that the first essential in dealing with this question is a more systematic regulation of industry, as a means to which it is suggested:—"(*a*) That the Government be urged to regulate the distribution of work under its jurisdiction, so that the necessity to discharge workmen will be obviated; (*b*) that the principle of regulating the distribution of work with the object as stated in Clause (*a*) be urged by the Government upon all public bodies, and recommended to private firms; (*c*) that the practice of working overtime be generally discountenanced; (*d*) that local public bodies, similar to those formed under Mr. Long's recent scheme for London, with the addition of a considerable proportion of the direct trade union representation, shall be permanently established in all localities throughout the country."

We undertake to say that no Government which hoped to retain the confidence of the electorate could ever attempt to tamper with the law of supply and demand in the manner suggested. What seems to be desired, is, that at a time when there is urgent need for the employment of extra hands on public works, the Government should resist the temptation to give temporary employment, in order that the permanent staff should have sufficient work to do all the year round. How such a proposal could be worked upon a sound financial basis, the Conference does not pause to inquire. "Regular employment at whatever cost" is to be the sovereign cure for every ill. In our view, it would be mere waste of time to urge this proposal upon the present or any other Government, and it is hardly necessary to add that it would be idle for the Government in its turn to make a representation to any employer of labour that it was his duty to so conduct his business as to give unintermittent employment to his workmen.

As to the suggestion that overtime should be discountenanced, we wonder what the opinion of those workmen who are sometimes asked to work overtime would be upon this part of the report. We have no doubt that a plebiscite of members of trade unions would support the suggestion of the Conference; but we suppose that skilled workers generally understand the advantages of "making hay while the sun shines."

The suggestion that the Government has it in its power to remedy the evil is followed up in Paragraph 4, where it

is proposed that works of public utility be commenced and carried out by the Government without delay. Amongst other "necessary" works, the following are enumerated:—The improvement of the Thames; coast protection against the encroachment of the sea and general reclamation of the land saved from such encroachment; necessary harbour works, and work already decided upon in connection with the Postal and other Government departments; the acquisition by the Government of waste lands at present unfit for agricultural purposes, with a view to afforestation. It is also suggested that the practice followed by public bodies of refraining from putting work in hand during the winter months, be, as far as possible, modified, in order that workmen may be more regularly employed throughout the year.

The proposal that the public money should be expended upon the above laudable objects comes well from the members of the Conference who, in another breath, have said that the resources of the country are being wasted in "extravagant expenditure"! In their view, apparently, no expenditure is extravagant so long as it provides employment; no unbusinesslike conduct on the part of a local authority or other public body should be called in question if it provides work for the workman. In the meantime, the opinions of the income-taxpayer and the ratepayer are to be wholly ignored.

Space does not admit of our entering further upon the consideration of this Report. We have said enough to show that, for our part, we do not agree with the proposals which it contains.

It is a matter for surprise that those who have held the fundamental tenets of trade unions for a number of years do not change their tactics, if not for good and all, at least by way of an experiment. We are far from saying that the trade unions alone are responsible for the trade conditions which have led to the lack of employment, from which so many good workmen are suffering at the present time. To attribute lack of employment or dullness of trade to any one cause would be to shut our eyes to the fact that trade depression is due to a number of causes, which happen to operate in one direction at one time. But—to take one example—may not the determined opposition of trade unions to labour-saving machinery and overtime for a number of years have had some undesirable effect? Whatever the reason, the year 1905 has opened with widespread lack of employment. Having tried a policy of antagonism to employers, and having found it wanting, might not the trade unions be prevailed upon to adopt a policy of conciliation? Would it not be possible for them to urge upon every workman the desirability of making the best use of his talents when work is plentiful, and so making provision for the time when his employer is compelled to work half-time or shut down altogether? In so far as it endeavours to inculcate a policy of thrift, no one can deny that the trade union is an admirable institution. Thrift is becoming more and more necessary amongst the working classes, in view of the fact that the tendency of modern times is to employ younger men. It was stated only the other day, at a meeting of miners in Glasgow, that, owing partly to the influence of the Workmen's Compensation Act, a man is discharged as soon as the grey hair begins to make its appearance in his head. In spite of this, the members of the Conference wholly ignore, or, at any rate, refuse to emphasise, the fact that it is the duty of each man to help himself.

The Telephone Purchase Question.

THE announcements which have appeared during the past week on the question of the telephone purchase would seem to indicate that some substantial progress has been made with the negotiations between the National Telephone Co. and the Postmaster-General. Certain rumours on the subject had their effect upon the National Telephone shares at the end of last week, and there was a good deal of matter let off in the daily Press as well. The official communication of the Postmaster-General was no doubt intended to allay any excitement or to prevent too much discussion before the terms of the proposed arrangement are known, but although he says that "there is no foundation for recent rumours that the business *has been acquired* by the Government," he adds that the negotiations are still proceeding. And that being so, it seems to us to be altogether premature for newspapers or experts to attempt to offer criticisms as to whether the bargain—whose terms and conditions, not being settled, cannot be divulged—is a good or bad one (see *Daily Chronicle*, January 9th). Although no further official announcement will be made before Parliament meets, it is satisfactory to know that the *pourparlers* which were, are now negotiations, and these negotiations may shortly be brought to a satisfactory conclusion. Lord Stanley, last session, gave an undertaking that no agreement between the State and the company should become binding until Parliament itself had had an opportunity of considering it. Parliament is timed to meet early in February, so that there is not now long to wait for some more definite pronouncement on this important question.

"Ships that Pass in the Night."

A CERTAIN well-known contemporary, whose contents are perforce "gassy," is treating the readers of its current issue to a crude pictorial effort, the exact interpretation of which is, to say the least, very obscure. To put the matter plainly, our gas friends appear to be suffering from a bad attack of "swelled head," a complaint which has been exceptionally prevalent with them since the holding of their exhibition at Earl's Court. It is possible that they have not fully recovered from the light-headed, semi-cooked and poisoned condition in which visitors to the above exhibition escaped therefrom. At any rate, some excuse must be found for the perpetrators of the pictorial enigma described below. Picture to yourself a vessel of curious shape—in fact a "sheer hulk"—with sails bellied out to the breeze, although absolute calm reigns on the mirror-like sea; the side of the ship is illuminated with the magic word GAS, casting, as might be expected, some local reflections. On the horizon, and half out of sight, is shown a rising or setting sun, labelled "electric light" and "waning," the latter word having apparently been added (not without good reason) to convince readers, against the evidence of their senses, of the inferiority of the sun (electric light) as compared with the illuminated GAS ship as a source of light.

Our gas friends may congratulate themselves that the sun (*alias* electric light) has not waned completely, otherwise their phantom ship would have been undiscernible in the outer darkness. Basking in the (symbolical) light of the sun, readers of the ELECTRICAL REVIEW will heartily sympathise with the mariners in their frail craft, recognising that long after the latter has been relegated to a place among the memories of the past, the former will still remain, unsuperseded, the light and energy of the peoples of this earth.

DISCRIMINATING RELAYS AND CUT-OUTS.

BY M. B. FIELD.

IT is difficult to account for the mystery which is usually supposed to surround the design and operation of discriminating relays and cut-outs for alternating-current circuits. For example, it is not infrequently stated that one type of relay* works well under certain conditions, and fails to operate under other conditions; while a second type will perform its functions in the latter case, but breaks down in the former. Hence, a vague impression exists among many engineers that no relay (short of one possessing superhuman intelligence) can be expected to discriminate correctly in every one of the multitudinous cases which may be presented to it, and answer unfalteringly the vital question—"Must the circuit be opened or not?" That this impression, if it exists, is a

* What is stated here with reference to relays is equally applicable to cut-outs.

mistaken one, will here be demonstrated. The criterion as to whether a discriminating relay should operate under *any* given condition is a perfectly definite and simple one, as we shall see later on. In the writer's opinion much of the difficulty of the subject is solely due to the unfortunate designation "reverse-current" relay. This is undoubtedly

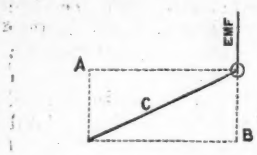


FIG. 1.

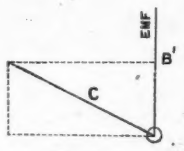


FIG. 2.

a misnomer. What exactly is meant by reverse-current when dealing with alternating-current circuits? In connection with continuous-current circuits, the phrase is a perfectly legitimate one, and presents immediately a definite conception. If we adopt the usual convention as to the direction of flow of a current, we can consider a "forward current" as one flowing in the direction in which the E.M.F. acts, and a current flowing in the contrary direction as a "reverse current." Or we may adopt the convention that a current flowing into the "A" terminal of a given piece of apparatus inserted in the circuit (*e.g.*, a relay), and out of the "B" terminal, is a forward current, apart from all consideration of the direction of the E.M.F. In this sense a polarised relay can discriminate between a forward and a reverse current without reference to the E.M.F. at all. Such a polarised relay is undoubtedly the correct principle to adopt in the case of continuous-current circuits, since its action and adjustment is independent of all variations in the supply voltage. Thus, should an excessive reverse-current occur which had the effect of reducing the supply E.M.F. to nearly zero value, the relay would still operate; while a forward-current, however large, would be ineffective in this respect.

In the case of an alternating-current circuit, the matter must be approached in a different way altogether. A current which *at every instant* is flowing in the direction in which the generated E.M.F. acts, is undoubtedly a "forward current," while a current which *at every instant* flows in the opposite direction is a "reverse current"; the first is in phase

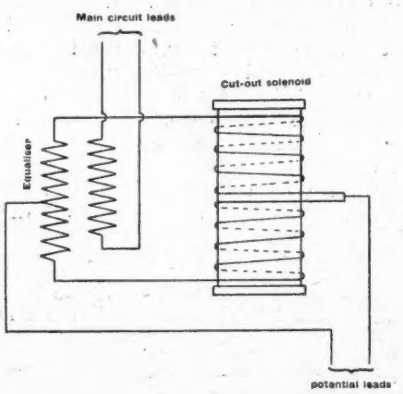


FIG. 3.

with the E.M.F., the second is 180° out of phase. This is all quite obvious, but what about the current lagging or leading by 90°? During half of each cycle it is flowing in the same direction as the E.M.F.; during the other half cycle it is flowing in the opposite direction. Such a current is consequently neither a forward-current nor a reverse-current, and, whatever its magnitude, should not cause a so-called reverse-current device to operate.

Now, let us consider a current which lags, say, a little more than 90°, behind the E.M.F. (fig. 1). We have then flowing in the circuit two currents superimposed, viz., O A and O B, not figuratively, but actually and really, these two currents exist. Now O A is, as we have seen, neither a forward nor a reverse current—as far as the relay is concerned, it is a nonentity. O B is then the only current we have to consider, and it will be noted that it is the *power component* of the current C. In fig. 1, O B is *at every instant* flowing in the opposite direction to the E.M.F.; hence, although the current C flows in the circuit, the *reverse* current is not C but O B. Had C lagged behind the E.M.F. by an angle less than 90° (fig. 2) there would have been no reverse-current, but a current of amplitude O B′ flowing in the *same* direction as that in which the E.M.F. acts.

The criterion, therefore, which must alone decide the operation of a successful relay is:—Is the *power* component of the current in the same direction or opposite direction at every instant to that in which the E.M.F. acts?

Having determined the specific condition or criterion which decides whether the ideal relay must operate or not, it is obvious that we have also determined the condition which must be made the *controlling principle* of the relay—in other words, the working principle of the relay must be so chosen that whenever this specific condition is absent, no matter what the other circumstances of the case may be, no *tendency* to operate is experienced by the relay. On the other hand, given the specific condition, viz.:—the existence of a reverse-power component of the current, however small, a *tendency* to operate must be experienced by the relay. We do not say the relay must operate, it may be inconvenient to make it too sensitive, or it may be wished to introduce a time element, but we reiterate that if the current has a component representing reverse-power, however small, a tendency to operate will be experienced by a properly designed relay, while a component representing forward-power, though it may be large enough to destroy the relay, will not produce any tendency to actuate its mechanism.

In the past numerous relays have been designed, which, in given circumstances, have proved unsuccessful, and the reason for this has not been that they were too sensitive or not sensitive enough, that they were too sluggish, or not sufficiently sluggish, but simply that the underlying principle controlling their movements did not necessarily coincide with or involve the single criterion which alone must determine the action of a successful relay. Thus, whereas the two conditions (viz., that which actually controlled the relay mechanism, and that which theoretically alone should control it) in numerous cases were co-existent, they were not necessarily so, and instances arose when this was not the case; hence the failure of the relay.

The question therefore arises, how are we to enable the relay to judge whether the main current contains a reverse power component? Clearly we must provide the relay with a sample of both the main current and the supply E.M.F. (in this latter respect it differs radically from the continuous current device). These samples, which must be produced in their correct phase relations, are usually obtained by the aid of current and potential transformers. We must then leave it entirely to the relay to discriminate.

If properly designed it will sift out the power from the wattless component of the current sample, compare this as regards direction with the sample of E.M.F. and make up its mind accordingly.

How, then, must the relay be constructed to enable it to achieve this result?

A simple differential solenoid is manifestly wrong, since a current, whether forward, reverse, or wattless, if large enough to swamp the effect of the shunt winding, would operate the relay. Such was pointed out by Mr. Leonard Andrews in his recent interesting paper on the subject, read before the Manchester Section of the I.E.E.

An obvious way to meet the case is by the use of a watt-meter relay, pure and simple, since reverse-current (as above defined) cannot exist without reverse-power. Clearly such a device will *tend* to operate with the smallest amount of reverse-power and will exhibit no such tendency with any amount of forward-power. If, therefore, it can be made sufficiently sensitive to operate with the smallest amount of reverse-power which constitutes a dangerous condition, it is evident that it will theoretically form an ideal relay. This principle was also mentioned by Mr. Andrews in the paper above referred to as first suggested many years ago by Dr. S. P. Thompson.

The necessity for a sensitive device becomes at once obvious when we consider that, although the actual current

flowing be large, the *power component* of the same may be very small. This is the real difficulty experienced hitherto with compound differential devices. It is manifestly incorrect to introduce, for this reason, spurious phase differences, as suggested by Mr. Andrews. This is merely overcoming one trouble, and introducing the possibility of another—inoculating with vaccine in order to prevent smallpox. If we introduce spurious phase differences between the samples

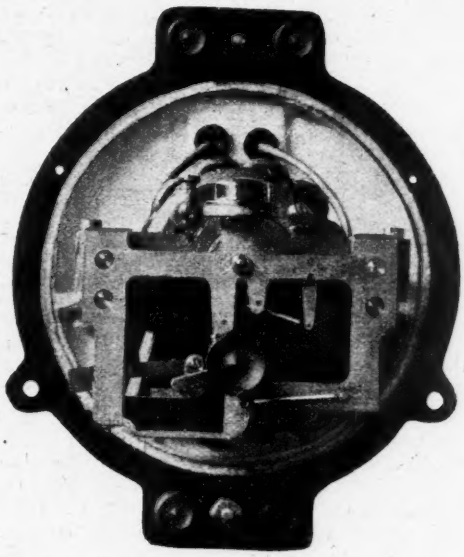


FIG. 4.

of E.M.F. and current, we shall find that with certain defined phase relations between main current and E.M.F., the relay will operate when it should not, and fail to operate when it should. True, the conditions involving these particular phase relations may rarely be met with in practice; they are nevertheless real and possible, and such a relay depends for its working principle upon a condition other than the criterion which should determine its action.

Having shortly dealt with wattmeter relays, we may touch upon compound differential devices. Several forms of these have been suggested.

The principle consists in two solenoids pulling a single armature in opposite directions. In the one solenoid the effects of the samples of current and E.M.F. are added, in the other subtracted. Imagine an armature symmetrically placed

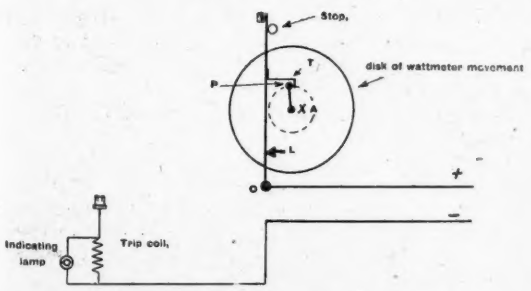


FIG. 5.

between the two solenoids, or two halves of a single solenoid, the magnetic circuit being such that the pull due to either solenoid is proportional to the square of the ampere-turns. The resultant pull at every instant will be proportional to $(v+c)^2 - (v-c)^2$, or $4\,v\,c$ where v and c represent the samples of E.M.F. and current respectively. The above expression obviously represents watts, that is, the mean pull on the armature is proportional to the average watts of the circuit, and will therefore be in the one direction in the case of reverse-power, in the opposite direction in the case of forward-power. We have introduced this—a purely hypothetical and ideal relay—on account of its similarity with the devices suggested by Mr. Andrews.

In the device shown in fig. 3, which is advocated by Mr. Andrews, the current in the top half of the solenoid corresponds to the difference $(v-c)$, and that in the lower portion to $(v+c)$. It is obvious that there is as much need for delicacy in this as in any other type. Sensitiveness, however, is not compatible with the particular design chosen, hence the reason for introducing spurious phase differences, which are wholly undesirable for reasons already pointed out.

Fig. 4 represents a reverse-power relay and indicator, as manufactured by Messrs. Ferranti. These relays will operate with any reverse power down to 10 per cent. of the full load of the circuit. This is found sufficiently sensitive to protect the average generator if the field circuit be opened—the severest test of a reverse-power indicator. A more sensitive device is not to be recommended. These relays can be made with and without time element. Fig. 5 shows diagrammatically the action of the relay. A weighted contact lever, L, pivoted at O, stands vertically. The wattmeter movement rotates about the axis, X (at right angles to paper), in a counter-clockwise direction with reverse-power, and tends to rotate in a clockwise direction with forward-power. Thus, the arm is positively held upright by the pin, P, in the wattmeter disk engaging in the projection, T, of the contact lever, as long as the transmission of power is in the

FIG. 6.

forward direction. On a reversal of power the wattmeter rotates in the counter-clockwise direction, and the pin P impinging against the lever causes it to overbalance and fall into the horizontal position, thereby establishing the trip coil and indicator lamp circuits.

Fig. 6 represents another form of reverse-power indicator, the usual switchboard type of indicating wattmeter being graduated in reverse-power below the zero. The photograph is taken with the pointer representing 300 KW. reverse power.

Lastly, fig. 7 illustrates a polarised reverse-current relay for direct-current circuits. In this device the serious disadvantage is absent under which all relays labour which have shunt and series coils combined differentially, viz., that the main current at which the device operates is largely affected by variations in the E.M.F. supplying the shunt winding. Further, it is found that many such differential devices will operate with a forward current, if sufficiently large to swamp the effect of the shunt winding. For example, a partial short-circuit which momentarily causes a drop in the E.M.F., frequently causes so-called reverse current devices of the differential type to operate.

The relay illustrated in fig. 7 is independent of the E.M.F. as regards its action and adjustment; and if provision be made for supplying the trip coils from a separate source, the action is as certain, though the E.M.F. drop to zero, as if no variation in it occurred.

Where a separate source is not available for the trip coils, it is best to design the latter to operate with certainty at one-

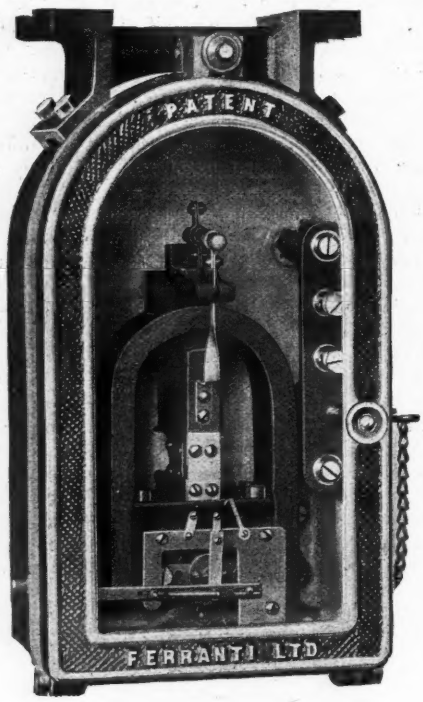


FIG. 7.

third normal bus-bar volts, and to withstand the application for five minutes of the full normal supply voltage. Fig. 8

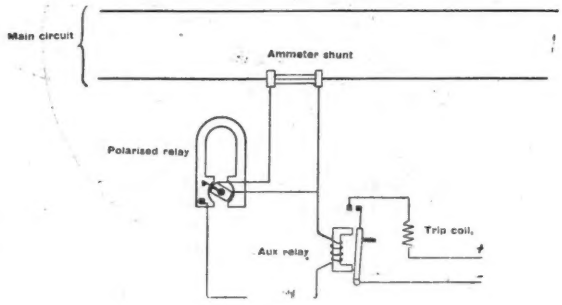


FIG. 8.

shows diagrammatically the connections of the relay illustrated in fig. 7.

ELECTRICAL LAW AND CASES IN 1904.

[FROM OUR LEGAL CONTRIBUTOR.]

IT will be timely and interesting to make a survey of legislation (if any) and of cases relating to electricity which have come before the public notice during 1904. We say "if any" advisedly, for the search for electrical legislation in 1904, is practically barren in its results.* Although the application of electricity to the spread of light and power is emerging from infancy to a period of hardy youth, the English statute law upon the subject is by no means so progressive. For the last two years an important measure has been brought before, but has not yet passed through, the House of Commons. We refer, of course, to the Electric Lighting Bill which was introduced in 1903, and which was brought up again in 1904, only to be dropped like a hot potato. Founded upon the Report of a Royal Commission, this measure had for its object (1) the grant of power to the Board of Trade to allow undertakers to acquire land compulsorily; (2) an alteration of the existing law as to compulsory purchase by the local authority of an undertaking of a company; (3) a proposal to deprive local authorities of the power which they now possess to veto the grant of a provisional order to private companies within their area. We sincerely hope that this important measure may make its appearance again during the session which is about to commence, and that it will become law in due course.

Passing now to consider some of the cases which have come before the courts during the past year, we cannot point to any which lay down any new or very startling principle. The following, however, are worthy of mention.

The case of Escott *v.* Mayor, &c., of Newport (20 T.L.R., 158), involved a question of considerable importance to local authorities and electrical companies who require to put up posts in streets for the carriage of electric wires. It appeared that in 1885, the plaintiff became tenant of a plot of land in Chepstow Road, Newport. Upon this land he built a number of houses, and he paved the whole of the piece of ground in front of a shop which was occupied by him. This was subsequently repaved by the defendants, and there was no question in the case that, subject to a right which the plaintiff reserved to himself, of placing furniture on the road in front of his premises from time to time, there was complete dedication to the public. In exercise of powers given to them by Acts passed in 1892 and 1897, the defendants constructed a tramway in this road passing in front of the plaintiff's premises. They then erected a pillar, without the plaintiff's consent, immediately in front of his shop. The plaintiff now complained that the placing of the pillar where it had been fixed was a trespass. The defendants contended that they were entitled to fix the pillar by reason of Sec. 51 of their special Act, which provided that, "for the purpose of working any of the Corporation tramways by mechanical power . . . . the Corporation may, subject to the provisions of this Act, construct, lay down, place, erect, maintain, renew, in, over or under any street in which any Corporation tramways are for the time being laid," certain works and appliances, including poles and posts. This Act incorporated the provisions of the Lands Clauses Acts, which, as is well known, provide for compensation being paid to persons whose property is interfered with, but the defendants contended that, by Sec. 149 of the Public Health Act, 1875, the Chepstow Road had become so vested in them that they were entitled to fix any posts in it without making any compensation to the plaintiff. The learned County Court judge, before whom the case came in the first instance, decided that there had been a trespass, and that the defendants had no right to place the post without paying compensation to the plaintiff. On appeal to the Divisional Court, this decision was in one sense reversed, and in other sense affirmed. Mr. Justice Kennedy, in giving judgement, said:—"It appears that what was done by the defendants, was not the taking of the soil, but an exercise by them of a statutory right in the nature of an easement, done within an area which prevented an act of trespass being committed. If any injury has been caused to the plaintiff through injurious affection of his land, he can put in a valid claim for compensation under the Lands Clauses Act . . . . . If our decision were otherwise, it would be necessary for public authorities to serve notices under the Lands Clauses Acts on every occasion when it might be necessary for them, in the execution of their duties in the laying of sewers or otherwise, to penetrate below the surface of the soil of a street." It will be seen that the result of this case was to leave the plaintiff with his claim for compensation if he could show that he had suffered damage. At the same time he was deprived of the right to seek an injunction to restrain the Corporation from allowing the post to continue in the position in question.

Electricity cannot, unfortunately, be generated in large quantities without a certain amount of inconvenience and discomfort being caused to those who live in the neighbourhood of the generating station.

The two cases of Knight *v.* The Isle of Wight Electric

* The Electric Lighting (London) Act, 1904, applies only to the Metropolis, and is not dealt with here in this article.

Light and Power Co., Ltd. (20 T.L.R. 173), and Colwell *v.* St. Pancras Borough Council (20 T.L.R. 236), are of considerable importance to electricity companies, and to local authorities who generate electricity, in view of the fact that in each case the Court granted injunction to restrain the working of a generating station so as to be a nuisance.

In the first case the plaintiff was the owner of a school at Ryde. The defendants had acquired a piece of land adjoining the school premises, and had erected thereon extensive works for the supply of electric light and energy, and for the manufacture of water gas in connection therewith. The plaintiff alleged that the running of the engines and machinery used in the works caused vibration and noise, which seriously interfered with the rest and repose of the plaintiff and the inmates of her house, and that the defendants also caused or permitted offensive smells of great intensity and injurious to health to be emitted from their works and to come upon the plaintiff's premises. In respect of these acts she claimed an injunction and damages. Mr. Justice Joyce, after a prolonged trial, held that the complaints made by the plaintiff were not merely fanciful. He said, in the course of his judgement:—"What the plaintiff complains of is what she has suffered from the working of the generating station and the operations carried on, and which would continue to be carried on there. Upon the whole I hold (1) that the acts complained of had from time to time, and frequently, been such as having regard to the circumstances and surroundings of the defendants' property, were in excess of the natural and ordinary course of enjoyment of that property; and (2) that these Acts had up to the trial materially interfered with the ordinary comfort of the existence of the plaintiff and her household." In the event he granted an injunction in the terms above mentioned

The other case above referred to also terminated disastrously for the supply authority. There the plaintiffs were lessees and occupiers of certain houses in Great College Street, in the borough of St. Pancras. In 1902 it came to the knowledge of the plaintiffs (whose premises were situated close by) that the defendants contemplated enlarging their generating station and increasing their electrical plant and machinery. Against this the plaintiffs protested on the ground that it was likely to add to the nuisance and annoyance arising from the vibration and noise of the electrical machinery from which they already suffered. The defendants disregarded this protest and erected their machinery. The plaintiffs said that the noise and vibration had so much increased since the new plant was installed that it became almost impossible to live in the neighbourhood. The defendants contended that the nuisance was due solely to the fact that the two engines were new and were not running smoothly. Mr. Justice Joyce, at the conclusion of his judgement, after drawing attention to the terms of the provisional order, which expressly stated that the company might be liable to actions for nuisance, said—"Notwithstanding that order, it is suggested that for months, or it may be for years, after the construction of the works, the defendants are entitled to cause a nuisance until such time as by experiment and alteration of their machinery they should be able to put a stop to it. That is a novel proposition to which I cannot accede. I would rather say that the defendants were not entitled to carry on their works unless they can do so without causing a nuisance." In the circumstances he granted the injunction asked for.

In the case of the Attorney-General and others *v.* The Metropolitan Electric Supply Co. (21 T.L.R. 10), which was heard on October 28th, a question arose as to the power of an electrical company to grant a supply elsewhere than in the district where a supply was authorised by their special Act. It appeared that in 1898 the defendant company found that they could not generate sufficient electrical power within their areas of supply, and they obtained another Act which authorised them to use a generating station at Willesden for the purpose of supplying those areas. Sec. 5 of the Act provided that:—"The undertakers shall not at any time after the passing of this Act supply energy or (except for the purposes of this Act) erect or lay down any electric lines or works beyond the area of supply otherwise than under the authority of Parliament, or under a licence granted by the Board of Trade under the principal Act." The land at Willesden upon which the defendant company erected their generating station, was not situated within the limits of any of the statutory districts which they were empowered to supply with electricity. In December, 1903, the defendant company commenced to supply the London and North-Western Railway Co., who have sidings adjoining their generating station at Willesden, with electrical energy from the said station. The Willesden Urban District Council objected to this on the ground that they were themselves supplying electricity in the Willesden district, and consequently they stood to lose a certain portion of their custom. They now contended that the supply by the company in the district was a violation of statutory duty. On behalf of the company it was contended that the company were entitled to give the supply under their general powers. Mr. Justice Farwell, in giving judgement, said that he could not find anything in the Act to give the defendant company power to supply electricity in Willesden. Sec. 5 was a prohibition which prevented the company from granting a supply, except in certain areas which were particularly mentioned. In the event, he granted an injunction against the company. When commenting on this case, in October, we drew attention to the fact that the reason why the District Council had moved the Attorney-General to bring the action was that they wished to keep the market at Willesden open for themselves.

The case of Manchester Carriage and Tramway Co. *v.* The Swinton and Pendlebury Urban District Council (21 T.L.R., 91), the facts of which were of a somewhat complex nature, raised a question of interest in connection with the sale of a tramway undertaking to a local authority. As our readers are probably aware, the promoters of a tramway may, in certain circumstances, be compelled to sell the undertaking, or so much of the same as is within the district of a local authority, to that authority, upon terms of paying the then value of the tramway, and all lands, buildings, works, materials, and plant of the promoters, suitable for use by them for the purposes of their undertaking within such district. In the case in question, the company owned a number of depôts which had been used for the purpose of working the tramway by horse traction. Some of these depôts were within the district of the District Council, and one (the Church Street depôt) was outside that district. Sir Frederick Bramwell was appointed arbitrator to settle the price to be paid. He made an alternative award, under which £49,006 was to be paid to the company if the District Council were bound to take over the Church Street depôt, and £24,689 if the Court should be of opinion that they were not so liable. Mr. Justice Channell held that the Council were bound to pay the larger figure. This decision was reversed by the Court of Appeal, on the ground that there was some uncertainty as to whether according to the findings of the arbitrator, the depôt in question was "suitable to and used for the purposes of the undertaking." In the event, therefore, the company were only awarded the smaller sum. It should be observed that the question which arose in this case was whether a local authority who intended to work a tramway by electricity could be compelled to take over property which would be of but little use to them. Had the depôt in question been a generating station or a sub-station, it is not likely that there would have been any dispute.

Another case in relation to electric tramways deserves a passing notice. The Sheffield Corporation, with a view to limiting their liability to passengers for accidents, printed upon the backs of their tram tickets, a clause to the effect that:—"Passengers are being carried at less than the maximum authorised charges, and every passenger is notified that, in consideration thereof, a passenger is only carried on the terms that the maximum amount recoverable from the Corporation on account of any injury or damages suffered by a passenger and for which the Corporation is legally liable, is £25. Except as above, every passenger travels at his own risk." A member of the City Council, who objected to this clause, refused to take a ticket which had the clause upon it, and as the company did not issue any other kind of ticket, he was summoned for non-payment of his fare. The magistrate found in favour of the Corporation, but consented to state a case for the opinion of the High Court. Before the case was reached, however, the Corporation withdrew the regulation which provided for this clause being inserted on the

tickets, which are now issued without qualification. We may mention that in an article which appeared in these columns before the clause was withdrawn,* the view that it was illegal had already been expressed.

In the case of Grenfell and Others *v.* The Directors of the South Lancashire Electric Traction and Power Co., which was reported in our issue of May 20th, 1904, an action was brought in respect of certain alleged misrepresentations in the prospectus of the defendant company, whereby (it was alleged) the plaintiffs were induced to underwrite certain debenture stock of the defendant company. It was stated in the prospectus that the defendant company was being formed to acquire the beneficial interest in, and to develop as parts of a single system, the rights of the South Lancashire Tramways Co., and the Lancashire Light Railways Co. The misrepresentation complained of was contained in a clause to this effect:—"The South Lancashire Tramways Co. is empowered by its Act to supply electric energy to local authorities for all purposes, and arrangements will be made accordingly." Whether or not such a power existed was, according to the case for the plaintiffs, a matter of grave doubt. The question turned upon the construction of the Lancashire Tramways Act, 1900, by which power was given to construct and work certain tramways, the general purposes of the Act being traction. By Sec. 85 the company were not to supply electric energy for other purposes than the purposes of the Act without the consent of the local authority. Before issuing the prospectus, the directors had taken the opinion of an eminent King's Counsel as to its meaning. After a protracted hearing, the jury found that the directors had taken reasonable precautions to ascertain that the statements in the prospectus were true, and judgement was accordingly entered for the defendants. Incidentally the question was raised (although not decided) in this case whether an electric lighting company has the right to supply electricity to local authorities unless power to do so is expressly conferred by Act of Parliament. In other words, has an ordinary supply company the right to supply electricity "in bulk?" Of course, a company has no right to grant a supply outside its area; but we have expressed the opinion that so long as operations are confined to that area, a local authority may be supplied just like any other consumer.†

The question as to how far a railway company who have adopted the third-rail system may be held liable for accidents caused by electric shock to trespassers on the line has not yet come before the Courts for consideration. We have already expressed the view, that unless an accident happens at a point where the public are "invited" to cross the rails, as, for instance, at a level crossing, the company are not liable.

With regard to employés of the company, the question is somewhat more complex, and is not likely to arise in such a form as to be decided in accordance with principles of common law, inasmuch as railway servants can make claims under the Workmen's Compensation or Employers' Liability Acts.

In the meantime it is interesting to consider the attitude of the Board of Trade towards "live rails."

In consequence of certain accidents on the "live rail" portion of the North-Eastern Railway, the Board of Trade took steps to ascertain whether any and what measures should be taken to prevent the recurrence of such disasters. In his report to the Board of Trade (which was approved by Mr. A. P. Trotter), Major Druitt, R.E., said:—"The provision of the protecting boards, especially the inside one between the power and running rails makes the work of packing the sleepers more difficult, as it is just under the running rail that packing is most required, and anything making that difficult is undesirable from a platelayer's point of view. The upkeep of the protective boarding will also require much attention, as the clearance between the shoe and the boarding must necessarily be small, and the latter will be liable to get out of place from the action of rain and sun; any contact between the two might result in a serious derailment. As far as experience goes at present, it does not appear necessary to provide boarding for the 'live' rail for the whole length of the line in order to protect the men employed in working the traffic, repairing the line, &c., or the passengers."

* Electrical Review, October 28th, 1904.

† See Electrical Review, May 20th, 1904, p. 814.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Burnley Refuse Destructor.

As from time to time doubts have been expressed in your journal as to the steam-raising value of town's refuse, we enclose an extract from a letter from the engineer-in-charge of the destructor plant at Burnley, where the results are so satisfactory that they have now had built a further installation to deal with the balance of the refuse of the borough. We doubt if there are many coal-fired boilers of the same size giving as much steam when burning best Welsh coal, whereas our fuel is unscreened town's refuse.

Meldrum Bros., Ltd.
J. W. M. } *Directors.*
W. H. S. }

Timperley, *January 5th*, 1905.

Extract from the "Heywood Advertiser," October 21st, 1904.

Re Burnley Destructor.

Until the end of August last a weekly return of water evaporated by the boiler was sent to the members of the Health and Electricity Committee. This water was measured by a Kennedy hot water meter, and for several weeks was checked by an automatic recorder on our 6 × 15 Weir pump. Just recently the makers of the meter have certified it as working correctly. The following figures are taken from the weekly returns for the quarter ended on June 25th:—

Refuse weighed in. Tons.	Water evaporated. Lb.	Refuse weighed in. Tons.	Water evaporated. Lb.
183	818,780	190	617,000
179	781,480	210	655,400
207	748,260	181	626,800
178	679,140	212	614,500
188	692,460	221	799,200
212	647,800	266	960,300
211	638,100		

In each of the above cases except the last, the water evaporated is for six days; in the last case it is for seven days.

[The figures here given show an average evaporation of 3,540 lb. of water per ton of refuse, or 1·58 lb. water per lb. of refuse, the highest figure being 2 lb. per lb., and the lowest 1·29 lb. per lb. Our readers will remember that in May last year some correspondence took place in these columns with regard to the performance of this destructor, arising from a note on p. 309 of our issue of February 19th last. The Meldrum "Simplex" destructor is capable of destroying 2¼ tons per hour, and the boiler is a 30 × 8 ft. Lancashire. 1·58 lb. steam at 130 lb. pressure from 90° F. is equivalent to 1·85 from and at 212° F.—Eds. E.R.]

Water-Cooled Rheostat.

It may be of interest to Messrs. Henry Lea & Sons to know that such a resistance as he describes has long been in use in this country, and that it is not necessary to go to the Continent for a method which is common in this country. I used a somewhat similar arrangement at Belfast in 1901, and have a similar arrangement here consisting of eight coils of Beacon wire of 2 ohms each approximately, which can be joined up in series or in parallel.

These coils are placed in a rectangular tub about 5 ft. long, 2 ft. 6 in. wide, and 3 ft. deep, through which cold water is passed when required.

G. H. P. Morgan,
Works Superintendent.

Barrow-in-Furness,
January 6th, 1905.

The tests described under the above heading in last week's issue of the ELECTRICAL REVIEW, appear to be quite new to Messrs. Henry Lea & Son, although the writer has used the same method of dissipating electric energy 10 years ago. It may answer fairly well for tests of dynamos on site where the wires can be cut to the exact resistance required to suit the individual machine, and not appear very troublesome, but when applied to everyday test-room work, its virtues are not quite so apparent. Its chief fault lies in the fact that it is not sufficiently universal in its application, when one considers that machines passing through a test room vary in capacity from 1 KW. to 1,000, and in voltage from 10 to 550, also the load on small machines—especially those of high voltage—cannot be adjusted to the exact amount unless an infinite number of connections be taken from the tank. Further, electrolytic action takes place where the current enters the tank, which soon causes the wires to be eaten through and fall to the bottom. This method, however, is still very useful when a low voltage booster is to be tested, but as these tests are not of frequent occurrence, the extra time taken and trouble in adjusting the load, are not taken into much account.

In the test taken by Messrs. Lea & Son, it is evident that the resistance of the wire was 22 ohms cold, as it was intended to allow 10 amperes to pass, but immediately the current was switched on the resistance increased to 44 ohms, this being due simply to the heating of the wire, which can be calculated from the usual formula :—

$$R_t = R_o (1 + a t)$$

R_o = res. of wire in ohms at 0° C.
R_t = " " " at t° C.
a = temp. coefficient of steel (about ·00625).
t = temp. rise of wire in degrees Centigrade.

Substituting the above figures, the temperature rise of the wire would be about 160° C. If the wire was actually halved, as stated, the resistance cold would be 11 ohms, which allowed 10 amperes to pass on the 220-volt circuit, the resistance evidently rising to 22 ohms, the temperature rise being the same as in the previous case. This, at first sight, appears somewhat paradoxical, owing to the fact that the emissivity of the wire has practically increased to four times its amount in the previous case, but when we consider that the wire was most probably stretched out after being cut, it is obvious that there would be a much freer circulation of water round the wire, thus increasing the emissive properties of the latter.

W. F. D.

Messrs. Henry Lea & Sons' interesting results seem to indicate that the temperature rise of the ·0085 in. wire was 200° C. average through its mass.

What is meant by "theoretical" volt drop? Surely they did not assume that the whole wire was at the temperature of the water!

Much information can be found in mathematical treatises dealing with the flow of heat.

The writer has seen a similar apparatus, the spiral being in a glass tube, used for heating water. This was several years ago. A glass tube seems preferable to a wooden box in many ways, and a big resistance could be made of a few of these in parallel.

Phlogiston.

Is Steel Conduit Wiring Doomed?

It is very amusing to read Mr. Wood's letter regarding the use of wood casing as a substitute for a complete draw-in conduit system, and above all places in a colliery, where mechanical protection is absolutely necessary, and condensation and dampness are serious troubles.

No doubt the installation Mr. Wood mentions was carried out by the local "electrical engineer-ironmonger," whose aim is to get the work done "good enough," and crowd all the wires he can in one tube. I should like to point out to Mr. Wood that, by virtue of experience at home and abroad, it is an easy matter to withdraw any one of the wires if the conduit system is carried out properly, viz., one circuit in each conduit, calculated accordingly with ample draw-in boxes and long radius bends; then it is only necessary to remove the ceiling rose or switch in order to withdraw the wires; all conduit joints to be screwed and butted end to end in the coupling. If condensation is the trouble, there are conduits and watertight switches, distribution boards, &c., on the market, which will do away with any anxiety there might be.

M. E. Heaton.

London, S.E., *January 7th*, 1905.

Harking back to Mr. Moss's letter in your issue of December 30th, and having been an earnest disciple of screwed steel conduits since their inception, I should like to add a few words to what bids fair to be a somewhat lengthy discussion.

I have carried out some large extensions, dating back some six or seven years, including a large amount of buried work, and I can safely say that I have never experienced any of the ills or defects that Mr. Moss incidentally mentions.

The only explanation I can give for his experience of repeated failures, is that the samples of work he has met with must be of very shoddy nature.

With an absence of sharp bends and a reasonable number of joint boxes to ensure accessibility, I have never found any difficulty in re-wiring or repairing portions of installations, in a few hours at most.

Of course, if the prices of jobs are cut very fine, as they often are nowadays, it is almost impossible to give the proper attention to, or employ skilled men to carry out, the work, and the ills and defects Mr. Moss speaks of will certainly make themselves felt; but is this the fault of the system? Would not any wiring system, under similar conditions, give the same results?

My contention is that screwed steel conduit, properly installed, is the best system we have as yet, whether concealed or otherwise.

From the fire risk point of view, it is almost impossible with screwed steel conduit to have a serious burn out, if the circuits are adequately fused; this is a matter that is very often over-looked by the jerry contractor, and branch fuses are sometimes put in large enough to carry the main current, by some inexperienced wireman or boy. The consequence is that in the event of a short circuit, the wire melts, instead of the fuse blowing, and necessitates the pulling out of a number of wires; but again this is surely not the fault of the system, but the result of employing cheap and incompetent labour.

I am afraid there would be a very bad time in store for us if we ever went back to anything like the obsolete wood casing that dies so hard, as it is neither mechanical nor electrical protection.

E. R. Mahood.

Brighton, *January 10th*, 1905.

A thoughtful examination of the actual results obtained during the past five years' use of metallic tubing as a protection for electric wiring, cannot fail to reveal, with painful distinctness, that it has proved a costly failure.

The necessity for a really satisfactory method of protecting and running electric wiring is so great that the merits and demerits of the various devices in use must be boldly looked in the face, and the imperfect system must fall into disuse.

There does not appear to be a really reliable all-round system at present in the market—that is to say, one which combines all requirements from both a mechanical and also an electrical standpoint, in conjunction with reasonable cost.

The disadvantages attendant upon the employment of plain metallic tubing are so enormous, and so obvious, that it is a most surprising thing that practical men should have seriously entertained the use of it.

Let us take a plain instance, and endeavour to realise the condition of affairs which really exists when the above form of protection is adopted.

Consider the case of a building fitted with the necessary wiring for 50 lights. Here we have many hundreds of feet of earthed metallic tubing, such tubing containing insulated wire carrying current at a potential difference of, say, 230 volts above earth.

The whole of the conductors are supported by and encased

in metallic tubing, and thus protected in a thorough manner, forming *mechanically* a happy combination.

But what is the position from an *electrical* standpoint? Certainly a most highly unsatisfactory and dangerous one.

It would, indeed, be difficult to imagine a much less desirable state of affairs when it is fully realised that hundreds of feet of charged conductor are merely separated from earthed metal by the thickness of their insulating covering, and that this amounts to about $\frac{3}{32}$ in. in many cases.

When the installation is first erected, an excellent test may perhaps be obtained as regards insulation resistance to earth, but this is solely due to the new and unimpaired covering on the conductors, and cannot possibly last; condensation of moisture in the tubes will speedily commence its fatal work of breaking down the insulating covering of the wires, with inevitable trouble to follow.

The plain fact of the matter is, that as long as insulated conductors are laid in bare metal pipes, so long will trouble and expense follow, and that such should arise is precisely what might be expected; in fact, it would be a miracle if it were otherwise.

Many half-hearted attempts to combat the above trouble have been made, but so far the *best* is not *thorough* enough.

Here the writer wishes to protest against tubing coated with so-called insulating enamel, for the coating in question is of such a paltry character that it merely gives a false sense of security, and is quite inadequate as an insulating lining.

By far the nearest approach to what is really required, is that of a certain firm who supply a conduit fitted with a paper lining, and this type will, when much improved, prove, in the opinion of the writer, the solution of the difficulty.

It will be necessary, however, to carry out the idea in a very much more thorough manner, that is to say, the paper must be of a good quality and of tough nature, and must be absolutely impregnated with a moisture-resisting and insulating substance, such as paraffin wax.

In addition to the above, there is another point of the most vital importance, which must not, under any consideration, be shirked, the point in question being that the actual thickness of the paper lining *must not be less than* $\frac{1}{8}$ *in.* for any size of tubing.

Given, therefore, a steel tube system of moderate gauge lined *throughout* as above specified, we shall have at our command a system from which the best results may be expected.

A. M.

January 3rd, 1905.

I was very pleased to read the letters by your correspondents, Mr. Edwards and Mr. Wood, in reply to mine, in your issue of December 30th, 1904.

It is plainly seen that the two writers hold extremely opposite views on the subject.

Although Mr. Edwards is aware that some so-called steel conduit systems give ample room for complaint, I must acknowledge the example, as given by him, does credit to steel conduit work and the contractors. In the third paragraph Mr. Edwards puts the blame on consultants; but look at the number of installations that are carried out where there is no consultant, and where the client is entirely ignorant of electrical matters, and that is, in my opinion, where a good deal of fault lies, although I most certainly agree with Mr. Edwards that some specifications do lack definiteness and detail, and I think a great many contracts are given out to firms who have tendered for one class of conduit (light gauge) while most probably many others have tendered for high-class heavy-gauge tube work.

In the fifth paragraph Mr. Edwards points out the principal details necessary for a high-class conduit wired installation, and if he will allow me, I would further add—the wires should not be drawn in until, in the case of new buildings, the plaster is dry. But how is this to be brought about? Where there is no hard and fast rule as to the quality of tubes to be used, and the method of erection, *some* contractors will still keep tendering for and using light-gauge tubes, and also crowding wires, and the consequence is, owing to this keen competition, these contractors *have* to be fought with their own weapons, and the light-gauge tubes are put in to make the jobs pay; hence the root of some of the trouble, and the condemnation of steel-conduit wiring.

If consulting engineers and architects will insist on materials and workmanship of the best quality being put in, then the faults which have of late been associated with conduit installations will soon be a thing of the past, except in those cases where contractors draw up and work to their own specifications—I do not include all contractors in this category.

In reply to Mr. Wood, I have, like himself, found some conduit installations a nuisance, and it has been necessary to pull down a great deal of conduit and wiring to remedy a fault. At the same time, I think he will agree with me, that if all conduit work was erected similar to the case Mr. Edwards mentions, with plenty of inspection fittings and plenty of room in the tubes for drawing wires in and out, there would be fewer faults and a deal less trouble in making them good. Regarding his suggestion about a conduit with a removable cover, I think the cost of such a system would be too great, and apart from that, what is the use of a removable cover when the work is all buried in plaster? There would also be a difficulty in the making of joints, and in the fittings in general with the system as proposed by him.

Whilst all this high-class work is being suggested, and an ideal system of wiring aimed at, we must not forget the cost, as the pockets of the public have to be considered, and there is, no doubt, a number of people who will cling to the old wood casing, rather than go to the expense of an ideal conduit installation; but where reliability is considered before cost, there is room for first-class conduit work.

H. Moss.

Birmingham, *January 10th*, 1905.

Nernst Lamps.

As, personally, I have had considerable success with Nernst lamps, I should like to add a few words to the correspondence on this subject.

Undoubtedly the chief factor on which the success or failure of these lamps depends is the variability of the voltage. The declared pressure in Stirling is 230 volts, and as, I am glad to say, we keep a very steady pressure, I find 215-volt filaments and 20-volt resistances give satisfactory results.

For some considerable time I have been using ½-ampere "A" type Nernst lamps fairly extensively for street lighting, and I find the average life of the filaments is about 800 hours.

I give below the lives of the last batch of 50 filaments, of which I have had the burning hours made up, and you will note the large proportion of filaments with the life over 1,000 hours. Undoubtedly the efficiency of the lamp falls off very considerably on such a long life as this, and for ordinary use it would certainly be judicious to change the filament after about 700 hours.

	First 25.	Second 25.
Under 100 hours ...	1	2
Between 100 and 200 „ ...	0	0
„ 200 „ 300 „ ...	2	0
„ 300 „ 400 „ ...	3	2
„ 400 „ 500 „ ...	3	3
„ 500 „ 600 „ ...	2	2
„ 600 „ 700 „ ...	3	2
„ 700 „ 800 „ ...	1	2
„ 800 „ 900 „ ...	1	2
„ 900 „ 1,000 „ ...	1	2
Over 1,000 „ ...	8	8
Average ...	781 hours.	806 hours.

I need hardly say that careless handling is fatal to the life of the filaments, and I largely attribute the good results I obtain to the fact that great care is exercised in the replacement of the burners. I wish all my customers were as careful.

The Luna burner I also find to be satisfactory, though, perhaps, hardly so reliable as the "A" type.

I have not obtained good results with either Luna or "A" type 1-ampere filaments, and though the old type of ½-ampere filament was reliable enough, my experience with the new "U"-type filament has been far from satisfactory.

In nearly all cases with this burner, I find the heating

coil has broken down apparently through contact on very close juxtaposition with the filament. A more powerful light is given off by this burner at the commencement, but I think the drop in efficiency is more rapid, and the life is very uncertain.

A. C. Hanson,
Burgh Electrical Engineer.

Stirling, *January 10th*, 1905.

I have read with much interest the various comments on the Nernst lamp in the Electrical Review.

I cannot see why so many fall into the error of allowing the lamp to be over-volted, for the makers do their best in their various pamphlets to point out how fatal this is to the life of the lamp. With regard to the variations in supply voltage, I would point out to R. Pippette that it is impossible, on a network of any size, to keep an absolutely straight line chart over the 24 hours; and I presume the variation he noted—namely, 22½ per cent.—is a clerical error, meant for 2½ per cent, the latter being allowed by the Board of Trade.

I have experienced very little trouble, and have got excellent results out of these lamps; but I venture to suggest one or two points where the makers may help us:—

1. In the correct voltage proportioning of resistance and burner. I have seen lamps voltaged for 230 volts sent out with resistance 15 volts, burner 215 volts, another with resistance 20 volts, burner 210 volts. Both cannot be correct.

2. I have often been asked by consumers how the light efficiency of the lamp after various hours of burning compares with the ordinary incandescent lamp similarly run, and I would suggest that the makers give us an efficiency curve showing this.

If contractors when installing Nernst lamps in a district would take the trouble to ask the supply company for the maximum voltage in that district, they would be only too pleased to supply this information. The resultant lamp would have a longer life and would certainly be more satisfactory. There would be less sulphurous language between contractor and consumer, and the supply would materially benefit.

S. R. W.

The Dignity of the Profession.

"Turbo" and others with like views prove themselves thoughtless and narrow-minded. Has it ever struck them that were their views upheld the engineering profession would have been deprived of many an eminent engineer and scientist? Sir Wm. Arrol's name is one now lying before me.

As to the dignity of the profession (dignity at 15s. to 25s. per week) I fail to see where the aristocratic or wealthy-born set, who make up a large percentage of a good many electrical staffs, uphold it. In an even number of cases it is found that were it not for the "common workmen" they would soon be in difficulties. I have met "common wiremen," and even jointers, who could teach more than a little to their supposed superiors. There is one good point—the "common workman" asks and gets a decent salary (I mean wage). He does not take positions at 10s. per week to gain experience and be able to say: "I am one of the engineeaws at the station doncherknow."

Might I ask if "Turbo" and his kindred fear honest practical competition? They may, for possibly "heads" are beginning to realise that.

Aristocracy (for want of a better term) and brains do not always go together, and it is even possible for a "common workman" to possess such.

I am sorry to have had to use such strong terms, but they alone fit the truth.

B.

I have read and re-read the letter on the above subject by "Impudence," and think he has assumed the most suitable *non de plume* possible.

I think I have come across the kind of engineer "Impudence" is trying to create; they are known in the profession as mushroom or half-inch engineers.

Fancy, "for an engineer to become proficient in his calling, he must of necessity take off his coat, &c., and don his overalls and indulge in the practical part of his business, and so educate himself in the matter of how each practical part of his business must be carried out." Things must have altered considerably of late years, and there is not the least doubt they have, for the general jobber and muddle mixer is everywhere in evidence, making the word engineer more and more ambiguous every day.

I really thought (and no doubt a good many of your readers had thought the same), until enlightened by "Impudence," that this particular indulgence that he speaks of in dealing with the practical part of his business was gone through by necessity in passing through the shops previous to assuming the name that the majority seem to covet, and to which the minority only have a right.

Truly this is a very elastic name, its ambiguity is infinite, but I am glad I know where I am now, for I have two sons coming along who, in the words of a famous song, might have been "following in their father's footsteps," which would have been entirely wrong, as I can see now, according to "Impudence." What a would-be engineer should do is to get a smattering, somewhere or somehow, of something allied to engineering, which will fit him to obtain his first appointment, in all probability in a central station or other place of opportunity, where he will be able to indulge in educating himself in the practical part of his business—or some other person's business—"unless, perchance, he be too dignified" to don the overalls; in such a case, of course, if he joins the staff as a jointer, he remains a common jointer, unless he takes over the chief's job.

It is the dignity of the profession that is being talked about, not arrogance.

These persons who have sacrificed their positions have sufficient elevation of mind, rank and character to permit them to take this step to prevent the name of Engineer being dragged further through the mud, and all credit is due to them for the noble example they have set.

Fear of encroaching on your valuable space prevents me from travelling further than paragraph 1 of this letter; but I consider the other three to be quite as illogical, and perhaps best left to themselves. If "Impudence" thinks he is doing this particular jointer a favour by pointing out the possible paths of improvement, I don't, for a thorough good jointer—a master of this particular branch of the profession—is a person that can command his fair share of respect, and should possess equal dignity with the other branches, as, undoubtedly, he does, thus obviating the necessity of jumping from one branch to another.

A Deep Thinker.

Doubtless most municipal station staffs will admire the engineers of West Bromwich, who resigned their positions rather than submit to the indignities the Electricity Committee have heaped upon them.

No unbiassed person would object to associate with a man who had risen from the ranks by dint of hard work and perseverance, but in municipal undertakings how often is this the basis for promotion!

In several instances that could be mentioned, rapid promotion has taken place in these stations simply by men "toadying," and the judicious expenditure of a little money (in drinks, &c.) on the members of the Committee, most of whom are totally unfit to control an electricity supply works.

If engineers would refrain from applying for, or accepting, posts vacated under these and similar circumstances, it would be to the benefit of the profession generally.

Why should not our Engineering Institutions protect the profession, which is so rapidly deteriorating?

Two Central Station Engineers.

Proposed Institution of Engineer Draughtsmen.

With a view to improving the professional position and encouraging professional and social intercourse and debate amongst members of this important, but somewhat obscure,

branch of all branches of engineering, I humbly beg to suggest to my brother knights of the board, through the medium of the Review, that an Institution of Engineer Draughtsmen be formed, covering all branches of civil, mechanical and electrical engineering, to which *entrée* could only be obtained on proof of training, education and strict examination. Such an offspring would, I'm persuaded, have the approval of the parent Institutions and employers, and pleasure and profit would be the lot of its members.

T² 45.

London, *January 9th*, 1905.

Contractor v. Hawker.

Referring to Mr. Stephen M. Johnstone's communication in December 23rd issue, what he complains of is only one means by which the manufacturer is doing his utmost to rob the contractor of his trade discounts.

I can give him one instance of the manufacturer who has actually had the audacity to engage the Corporation staff of the electricity department to hawk his goods about, and wherever there is a possibility of the customer giving an order, they will fix up these "hawkings" on "approval" entirely free to the said customer; the ratepayers, of course, stand the erection cost, and any other small items incurred. In the case I am referring to, these customers are actually offered the goods 3¾ per cent. less than the contractor has to pay for them!

The staff of the said Corporation is prepared to supply, or to be the intermediate party of anyone requiring, electrical materials in this town, and will see that they always get them at net trade prices.

I believe this is much more serious than what Mr. Johnstone complains of, and I should like to know if other contractors have experienced it, and what steps can be taken to stop it.

The remuneration paid to these Corporation hawkers, the writer presumes, will be admitted to be something more substantial than the ordinary Christmas-box.

A Contractor.

A Correction.

We notice in your issue of the 30th ult., in the Continental Notes, reference to an increase of our company's capital. We beg to inform you that our capital has been increased from £100,000 to £150,000 and not as stated by you, from £50,000 to £150,000. The dividend of 9 per cent. was declared upon £100,000 and not upon £50,000 as mentioned by you.

We shall feel obliged if you will kindly make the necessary correction in your next issue.

The Berliner Telephone Manfg. Co.
J. B. Birnbaum, *Manager*.

London, E.C., *January 6th*, 1905.

Engineering Text-Books.

I would like to hear of a circulating library containing a comprehensive collection of books on up-to-date engineering practice. Because I think there are many who will welcome such information, I inquire through your columns.

Australian.

Deficient Accommodation on a London Tube.

Respecting this subject of electrical traction, and the great boon it should—and, in most cases, does—confer on the travelling public, may I ask if any readers of this journal has ever had the experience of travelling on the City and South London Railway from Moorgate Street or Bank stations towards Clapham Common on a Sunday night between 10.30 p.m. and 11 p.m. The number of people crowded into one train is absolutely criminal; and, instead of, as on an ordinary evening during their busy time, running a three-minute service and a five-coach train, to attempt to deal in some manner with the crowds waiting on the platforms, their ordinary short trains of four coaches run about every five or six minutes.

If a fire, or anything else should occur to cause a panic in one of the tunnels, it would mean the greatest disaster of the age.

There has been ample time for these things to have been noticed and altered, as they have been going on for at least three months from my own personal experience.

I fail to see any object in preserving the antiquity of the above line; and, as an object of historic interest, a model in one of our museums would no doubt be sufficient to satisfy "the few"; but "the majority," I feel sure, would more greatly appreciate a few simple reforms for their own personal comfort and safety, which they certainly have *well* to pay for.

Seeing, as I do, the enormous advantages of electric traction over other kinds of locomotion, it is a pity to notice how badly this *pioneer* of the business in London compares with the ordinary steam-driven systems of dealing with traffic.

Last Hope.

Inquiries Addressed to Municipal Engineers.

I receive, as I suppose other municipal engineers do, continual strings of questions, 20 to 100 in number, mostly of a technical nature, from other municipal electrical undertakings, with a request they shall be replied to as soon as possible. Of course a certain amount of this is unavoidable, committees order it and so forth; but there is a great deal more in my opinion, than is desirable. It seems to be the fashion now if anyone wants to read a paper to bother the station engineers for all the facts. The enclosed is typical, and I think the views of other station engineers might be interesting.

Destructor.

[Our correspondent's complaint is one which has often been brought to our notice; town clerks especially seem to be addicted to the practice of applying, as of right, to their municipal *confrères* for all kinds of information, some of which involves a good deal of research and investigation and a considerable expenditure of time. Doubtless this tendency arises from a feeling that all municipal staffs, being in the service of the public, should cheerfully contribute their quota to the common good, while they may count upon their courtesies being reciprocated in kind, should the necessity arise. We ourselves are greatly indebted to both municipal and other station engineers for information, which we ask for as a favour, certainly not as of right; and we gladly testify to the good-natured and courteous response almost invariably accorded to our applications. Being, therefore, to some extent involved in this matter ourselves, we refrain from expressing an opinion thereon, but our columns are open to those who wish to do so.

In this connection, we may mention that we have become aware that a letter asking for certain particulars intended for publication in the Electrical Review is being circulated amongst municipal station engineers; we, however, have not received any communication from our prospective contributor, nor have we any idea as to his identity; needless to say, therefore, that we have not authorised the circulation of any such inquiry.—Eds. E.R.]

Civil Engineers—4 per cent.

On behalf of several young engineers, may I draw attention in your columns to the extraordinary lack of courtesy shown us by Central Station "Chiefs" when we apply to them for jobs.

Merely to quote my own case, out of over 25 applications which I sent out (in many cases enclosing a stamped addressed envelope for return), only *one* chief was polite enough to send me an answer.

Surely these chiefs might remember the following facts:—

1. That they were young men themselves once—looking for work.
2. That those of us who apply for work are, in the vast majority of cases, well trained, well educated gentlemen, and are entitled to be treated as such.
3. That civility costs nothing.

Indignant.

Inquiry.

Fire alarm and telephonic system for large public institution. Can any reader inform me of an efficient installation that has recently been erected as above?

H. W. A.

The Cult of the Marine Engineer.

I have been considerably amused (and not only myself, but others) at a letter in your issue of November 25th last, signed by "Landsman," on "The Cult of the Marine Engineer." It is so absolutely evident, from the letter in question, that "Landsman" is a disappointed marine engineer, that we, who happen to be electrical engineers in central stations, can only treat such a letter with pity and amusement. To begin with, he appears to imagine that the only duties of a chief engineer in a central electric light station are to look after his boilers, engines, and his consumption of coal per unit generated. He imagines that the only electrical work required is that of "moving the switches about," and that this can be done by a good electrical assistant. "Landsman" seems to ignore, or forget, that even the very best assistants like to be able to look up to their chief as a man of superior knowledge in all departments connected with a central station. There are such things, even in a semi-civilised country such as this, as intricate networks of cables, outside the station, and unless a chief is an electrical engineer, and can tell his men what to do, he is absolutely useless, although he may bring his coal consumption per I.H.P.-hour down to 1¼ lb.

As regards this latter figure, electrical engineers (who, of course, know nothing about steam) will, I think, take it with a grain of salt. He also forgets that a chief in a central station has to be a very first-rate business man. I really fail to see how a marine engineer can lay claim to this latter qualification, because, on "Landsman's" own showing, it appears that his only recreation, when not on duty (and I have rarely seen a chief marine engineer on duty) is that of conversing politely with the fair sex.

Here I agree with "Landsman." They are past-masters at the art! Put him in an office, with an irate consumer, who is swearing that his meter is reading 10,000 per cent. more than it should, and see how he will tackle him. He will probably have the meter tested by an assistant, but if that assistant asks him for any information as to how to do the job, he will probably say, "If you can't do it I must get someone who can." There are also such things as meetings of directors and electricity committees, when a chief is expected to report upon and advise with regard to technical electrical matters, and he could hardly send his "good assistant" to do this for him.

Why on earth marine engineers can't stick to their own profession instead of trying to oust men who have probably spent their time in training for electrical work and central station management, I cannot understand. We don't try to oust them; no doubt many of us would like the pleasant life, but we do not aspire to such heights of knowledge. It is also amusing to learn "Landsman's" idea of a gentleman. Apparently, if a man can talk nicely to a lady he is a gentleman. I may say that I have heard that some of the greatest scoundrels unhung have a delightful way with the ladies, and if this is the only qualification I am exceedingly sorry for the old stamp of gentleman. Many men who *are* gentlemen are quite shy with the other sex.

Colonial Electrical Engineer.

South Africa, *December 21st*, 1904.

P.S.—I have heard of stations which are run by "mere" electrical engineers, which have got their coal consumption down to even 3 lb. per unit.

THREE-PHASE ELECTRIC HAULAGE PLANT AT SHIREBROOK COLLIERY.

FROM the number of papers on electrical engineering read before the Institution of Mining Engineers, it is evident that the use of electricity in mines is becoming a potent factor in the mining industry. Whether continuous or three-phase current is the best for general mining purposes is a much disputed point, there being strong advocates for both systems. The great disadvantages of three-phase motors are the difficulty of starting the drop in voltage and the sudden rush of current when starting. Continuous current motors are handicapped by their commutators, but are more efficient in their working, and, when properly attended to, are probably much more suitable for many purposes than three-phase motors. Both systems, however, have their advantages as well as their disadvantages, and no hard and fast rule can be made, but each system should be carefully considered with regard to all the circumstances, depending upon the nature of the work and the state or position of the colliery.

In a paper read before the Mining Institute, Mr. William Hay describes a three-phase installation for hauling at Shirebrook Colliery. This plant consists of a pair of compound steam engines, fitted with Meyer expansion gear, and running at 95 r.p.m., supplied with superheated steam, driving, by means of a belt, a countershaft; and from this countershaft, by means of belts, is driven the three-phase generator and a separate exciter. It may be noted here that this countershaft means a loss of probably 10 per cent. to 15 per cent. of the power of the engine. Why colliery people prefer low speed engines and antiquated countershafts and belts it is difficult to say. One idea is that a low-speed engine is not so complicated as a high-speed one, and will not wear out so quickly. This is probably true when the valve gear merely consists of eccentrics and slide valves, but in these days of great economy in steam consumption and intricate and delicate valve gear of a low-speed engine, the high-speed engine is probably the simpler of the two; and, moreover, the great reduction in space occupied, and consequently lessened expense in engine house and foundations, to say nothing of getting rid of belts and countershafts, are most important points in favour of the high-speed engine.

The alternator is a three-phase ten-pole Westinghouse machine with an output of 75 KW. at 440 volts and a periodicity of 60. The field excitation is derived from a separate exciter consisting of a 1·5-KW., 125-volt compound-wound generator running at a speed of 1,300 r.p.m. The alternator runs at a speed of 720 r.p.m.

From the generator, the current is conducted by a three-core cable, 2,160 ft. long, to the motor underground, which is a Westinghouse three-phase motor of 100 H.P. at 400 volts, with a speed of 580 r.p.m., the rotor being of the squirrel-cage type. The machine is started by means of auto-transformers, and consequently, though the power required to start the motor is great, it is necessary to disconnect the rotor from the haulage gear, and start it light. The power from the motor is transmitted to the haulage gear by means of a belt 13 in. wide to a first motion pinion, and through double helical spur gearing to the rope-driving pulleys. The pulleys driving the hauling ropes are 6 ft. in diameter, and are thrown in and out of gear by means of a friction clutch of the ordinary wedge and expanding ring type, worked by means of hand-wheels and screws; and the speed of the haulage ropes, which are endless, is two miles per hour. The tightening arrangement consists of a balance bogie carrying a pulley 5 ft. in diameter working on an inclined plane; and the tubs are run in trains of 6, or, where the roadways are single, in trains of 14.

The following table gives the results of a 6-hours' test made with this plant:—

I.H.P. OF THE ENGINE AND THE DISTRIBUTION OF THE POWER.

	H.P.	Per cent.
Engine and countershaft	30·74	29·6
Alternator and exciter	10·18	9·8
Cables, motor and hauling gear ...	21·04	20·3
Ropes	8·87	8·5
Load, including coal and tubs	33·07	31·8
Totals	103·90	100·0

What strikes one most is the power absorbed by the engine and countershaft, though, as the engine is only working at half its load, this should be taken into account in its favour. The mechanical efficiency of the engine *plus* the power used to overcome the friction of the countershaft and belts is 0·8, and the electrical efficiency is 57·3 per cent. The steam consumption is 38 lb. per I H.P. per hour, which one would think—in spite of the 248 ft. of steam pipe—might be improved upon.

LEGAL.

HIGNETT *v.* FELLINGHAM.

AT Brighton County Court on Friday, Judge Scully heard a case in which Geoffrey Hignett, trading as G. Hignett & Co., electricians, of 2, North Street Quadrant, Brighton, sued Ernest Edwin Fellingham, electrician, of 10, North Street Quadrant, for £25 damages for breach of agreement respecting the sale to the plaintiff of an electrical business carried on by the defendant at 1 & 2, King Street, Brighton. The plaintiff also asked for an injunction restraining the defendant from committing further breaches of the agreement and from trading in Brighton, Hove and Preston. Plaintiff's case was that in 1900 the defendant, who was trading as Fellingham Bros, wrote and asked him to buy his business for £170, and witness ultimately agreed to purchase for £135, and to take defendant into his employ. An agreement was drawn up, and in this the defendant undertook not to do any electrical work in Brighton, Hove and Preston, but early last year defendant left witness and managed a business at 10, North Street Quadrant. On the shop were the words "Fellingham, Electrical Contractor, Electric Lighting, Estimates Free." Defendant's brother claimed to be the owner of the business. Plaintiff denied that the agreement was limited to a period of two years.

For the defence it was urged that plaintiff had no right to an injunction owing to the great delay in taking proceedings. It was also contended that defendant had not worked in his own name or on his own behalf, but for his brother.

The Judge held that the plaintiff's claim and defendant's counter-claim for the rectification of the agreement, must be dismissed, but in the event of his ruling being wrong, and the case going further, he found that if plaintiff's construction of the agreement was correct, defendant had broken it, but not for long, he having ceased to carry on business himself after he had been written to by plaintiff's solicitors on the subject. On the assumption that plaintiff's view was correct, he assessed the damages for the breach of the agreement at the nominal sum of £5, with costs on Scale C.

SPEARING *v.* BABCOCK & WILCOX AND OTHERS.

IN the Appeal Court on Wednesday, before Lords Justices Vaughan-Williams, Romer and Stirling, commenced the hearing of the appeal by the plaintiff in this case from an order of Mr. Justice Warrington, who dismissed an application by the plaintiff for leave to administer interrogatories to the various defendants in the action, on the ground that they were irrelevant. The defendants were Messrs. Babcock & Wilcox, Messrs. Sugden, Ltd., and Mr. John Sugden himself. The statement of claim, said Mr. Shearman, K.C., set out that the plaintiff and Mr. Sugden, who were engineers, were concerned together in certain inventions for water-tube boilers. Messrs. Babcock & Wilcox made water-tube boilers of a similar kind, and plaintiff and Sugden were associated together in Babcock & Wilcox's service. In 1902 a company called Sugden's Ltd., was incorporated for the purpose of carrying on business in the Sugden boilers. Shortly after this plaintiff became a large shareholder in Sugden's, Ltd., and manager of the company, and Sugden became another shareholder. The business was successful, and had come into competition with Babcock & Wilcox, who commenced two actions. The first was against Sugden's, Ltd., for infringement of patent, and the other against Thos. Sugden for damages and an injunction on the ground that he had committed a breach of his confidential relations. Mr. Spearing was only a party to the first action, but the company instructed solicitors to defend both. Mr. Perks, a solicitor and a well-known public man, was a shareholder in Sugden & Co., Ltd., and he commenced negotiations on his own account for the settlement of the actions, which ended in an agreement, and this agreement Mr. Spearing now sought to have set aside. Interviews were held between Mr. Sugden and Mr. Rosenthal, the manager of Messrs. Babcock and Wilcox, at some of which Mr. Perks's clerk, one Mr. Peck, was present. At the first of these interviews held at Mr. Perks's office, Rosenthal informed Sugden that Babcock & Wilcox had set aside £30,000 to fight the action, and would carry them through every court, and that he, Rosenthal, was the best friend Sugden had, and the only man who could save him from ruin, and further that Sugden was not so much to blame as Spearing in the matter which had led up to the actions. Consequences were hinted at, and a settlement was suggested. Sugden and Rosenthal informed Perks of the terms which Rosenthal proposed, and Perks said that in his opinion they were fair and reasonable, and that Mr. Sugden ought to agree to them. Sugden informed Mr. Spearing of the position, and entreated him to accept the terms in order to save him from ruin. In addition to the agreement put before Mr. Spearing for him to sign, these parties made a secret agreement with Mr. Perks and with Mr. Sugden. They agreed to buy up all Mr. Perks's shares in Sugden & Co., Ltd., at par, so that when Mr. Perks said the terms were reasonable he referred to his own agreement as well as the other. As to Mr. Sugden, they took him back into their service, and took over a patent of his. On discovering these secret terms, Mr. Spearing declined to perpetuate the agreement. He had employed Mr. Perks's clerk, Peck, as his solicitor to go into the matter, and Peck received a fee of 20 guineas from Babcock & Wilcox. He seemed to have been more or less retained by the other side. The only claim against Mr. Spearing was to restrain him from being a party to certain patents, but by the agreement he bound himself not to manufacture any water-tube boilers in competition with Babcock and Wilcox for three years. Counsel contended that there was clearly a duty to disclose these secret terms. It was, on the face of it, a *mala fide* transaction.

Hearing adjourned.

BUSINESS NOTES.

Electrical Industry and Tariffs.—It had been anticipated at Preston, where there are situated large electrical works, that Mr. Chamberlain would in the course of his speech on Wednesday night refer in some detail to that branch of the engineering industry. Mr. Chamberlain has, however, telegraphed to the special Lancashire correspondent of the *Engineering Times*, who communicated with him on the subject, that he has "no present intention of referring to that particular trade."—*Daily News.*

Electrical Omnibuses in Germany.—A service of electrical omnibuses, supplied with current from an overhead conductor, has lately been started between Nieder-Schöneweide and Charlottenthal, near Berlin.

The German Machinery Trade in 1903.—The Diplomatic and Consular Report, No. 622 (Miscellaneous Series), gives a report on this subject by the British Consul-General at Hamburg, states that during the last three years the progress has not been so rapid as during the previous decade, the total value of the exports having increased from £10,035,000 in 1901 to £11,600,000 in 1903. The imports, which in 1900 reached the high figure of £5,055,000, fell to £2,855,000 in 1903. The imports and exports of electrical machinery were as follows:—

	Imports.	Exports.
1901	£174,500 ...	£996,750
1903	80,750 ...	1,086,050

The chief markets for German exported electrical machinery were:—United Kingdom, £289,550; Russia, £98,700; Italy, £87,100; Belgium, £98,500; Spain, £73,300; the Netherlands, £62,450; Austria-Hungary, £45,700; Sweden, £39,800; Argentine Republic, £38,400; Switzerland, £29,100; and France, £25,100. The electrical machinery imported came chiefly from Switzerland, £31,900 in 1903, and £47,900 in 1901. Particulars are also given of the trade in agricultural, spinning, weaving, pumping, &c. It is interesting to note that "cotton-spinning machinery has at all times been almost exclusively imported from the United Kingdom." "Rolling machinery, ventilators, machinery for cutting metals, as well as working wood, were all imported chiefly from the United Kingdom."

The Spanish Copper Industry in 1903.—A recent Foreign Office report on the "Mining and Metallurgical Industries of Spain" contains some interesting information, from which a few of the references in regard to copper are worthy of quotation. Copper ore is obtained from 501 mines employing over 12,000 hands, and 54 steam engines aggregating 2,030 I.H.P. The volume of the ore raised was 2,799,789 tons, valued at the mouth of the mine £1,569,369. The increase in volume mined was 181,135 tons. Of the total output nearly 60 per cent., or 1,660,092 tons, was worked up locally into copper cascara (valued at £551,806), copper blister (valued at £416,021), and copper sulphate (valued at £88,596). Nine factories were devoted to the working of the ore into these forms affording employment for 3,300 workers. The motive power employed was steam; 30 engines, indicating 1,587 H.P., were in use.

Switzerland.—The balance-sheet of La Société Franco-Suisse pour l'Industrie Electrique for the last financial year, shows a profit of £31,160.

Imports of Foreign Electrical Apparatus.—A very steady tone prevailed throughout the past year in the importation of foreign electrical goods into this country. The returns now available show that the monthly total ranged between a minimum of £50,401 and a maximum of £86,236, the aggregate for the 12 months being given as £790,799, as contrasted with £819,029 in 1903.

German Electrical Machinery Imports and Exports.—Last year saw an increase in the importation of foreign electrical machinery into Germany, the returns for the 10 months ending with October last showing a total of 1,169 tons, as compared with only 725 tons in the corresponding period of 1903. On the other hand, there was a decrease in the exports of German electrical machinery from 11,187 tons to 11,066 tons.

The Jandus Twin-Carbon Lamp.—Messrs. Drake and Gorham, Ltd., sole agents for the Jandus Arc Lamp and Electric Co., Ltd., have forwarded us particulars of the Jandus twin-carbon lamp for working singly on 200 to 250 volts at 2½ or 4 amperes. The resistance for the former is self-contained, but with the higher current it is external. We understand that the lamp combines the usual features of Jandus lamps—sound design, solid construction, ease of trimming, and long burning hours. The overall length is only 2 ft. 3 in. The firm will send copies of the lists on application to them at 66, Victoria Street, Westminster, S.W.

Private Bills in Parliament.—The period allowed by the two Houses of Parliament for depositing memorials alleging non-compliance with the preliminary Standing Orders in respect of any of the first 100 Bills on the general list of constructive measures relating to public and private works closed on Monday. The *Financial Times* says that the memorials lodged included one by the Willesden Council against the Metropolitan Electric Supply (Various Powers) Bill; by the Northamptonshire County Council against the Wellingborough and District Tramroads and Electricity Supply Bills; by the Willesden Council against the Metropolitan Railway Bill; and by the Bexhill Corporation against the Hastings Tramways Bill.

The *Daily News* says that among the Bills which will be unopposed at the preliminary stage are the following:—Administrative County of London and District Electric Power Co.; South Metropolitan Gas; Charing Cross and Strand Electric Supply Corporation (Power Supply); London County Council (Tramways); Metropolitan Pneumatic Dispatch Co.; London United Tramways; East London and Lower Thames Electric Power; and the Central London Railway (New Lines).

Tramway Lifeguards.—Messrs. Hudson & Bowring, Ltd., have secured contracts for fitting up cars with the "H.B." patent lifeguard on the following:—Birmingham and Midland Tramways; Chesterfield Corporation Tramways; Lincoln Corporation Tramways; Penang Electric Tramways.

New Zealand Customs.—The following was gazetted during November:—Slot rails for tramways for cable or electric conduit, as tramway material n.o.e., 20 per cent.

A Glow Lamp Pendulum for Workshops.—(By our Berlin Correspondent.)—In connection with the artificial lighting of workshops, it is often desirable that the illuminant should be susceptible of a lateral displacement, especially in cases where the work or tool is to receive an illumination not only intense but also coming from a given direction. The efficient lighting of a drawing board, for instance, is ensured by placing the lamp in the immediate neighbourhood of the working place and to the left of the draughtsman. This condition can, however, be complied with only by

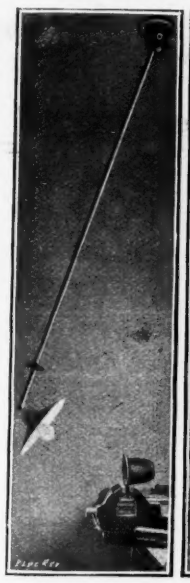


FIG. 1.

FIG. 2.

virtue of a lateral displacement of the lamp, and the same is true of the lighting of inclined drawing boards, when a vertical adjustment of the lamp likewise proves necessary. With the lighting of vices, lathes, and, in fact, wherever any pieces are being worked on or mounted, it will always be advisable to have a means of adjusting the lamp, so as to ensure an illumination of the working piece as

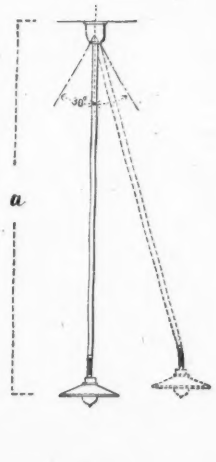


FIG. 3.

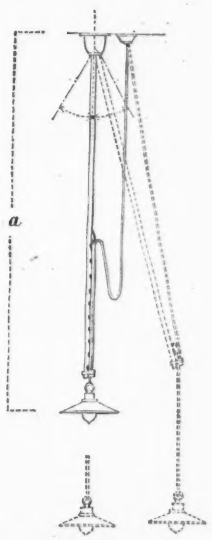


FIG. 4.

efficient as possible for the operation concerned. A practical device for this purpose is the Högner workshop pendulum, represented in the accompanying figures. This is a tube pendulum fitted with a friction joint, arranged in the upper part of the tube, that allows of the pendulum being laterally displaced within certain limits. Fig. 1 shows the pendulum lamp in connection with a vice, and fig. 2 with a lathe. Immediately above the lamp there is another friction joint, allowing of the lamp being given an inclined position. Whenever the latter is intended for permanently hanging in a vertical position, a short piece of flexible metal tubing is inserted between it and the pendulum (fig. 3). The length *a* can be made to suit any requirements. As the conductors are led through the tube constituting the pendulum, and as the latter takes up only a small amount of space at the ceiling, it may be installed anywhere, even in shops, containing a number of overhead belt transmissions. A special form of pendulum is represented in fig. 4. This is a combination of a directing and a flexible pendulum, both of which are fixed to the ceiling side by side, the flexible pendulum being led through a pulley, provided at the lower end of the outfit. This combination allows of the lamp being readily given a lateral displacement and any adjustment required, while the working place is disencumbered during the daytime by the pendulum being moved aside. It also permits of a vertical displacement of the lamp, a hook attached to the suspension being fitted into holes made in the pendulum. These pendulums are being manufactured by Messrs. Högner and Weller, of Leutsch, near Leipzic, Germany.

Spain.—A new electricity meter, known as the "L.W.," introduced by the Allgemeine Electricitäts Gesellschaft, has been officially approved for use in Spain.

Auction Sale.—On Tuesday, January 31st, at Wolverhampton, Messrs. Fuller, Horsey, Sons & Cassell will offer for sale by auction an extensive collection of nearly new, high-class machine tools, of which some details appear among our advertisements today.

Catalogues, Calendars, &c.—A list of luminous electric radiators has just been issued by MESSRS. BAXENDALE & CO., of Miller Street Works, Manchester. Various designs are clearly illustrated and prices are given.

Leaflet No. 84/1 issued by the ELECTRICAL CO., LTD., gives current prices for carbons for flame arc lamps.

A new price sheet relating to opalescent arc lamp globes is being circulated by MESSRS. DE GRELLE, HOUDRET & CO., of 130, London Wall, E.C.

FROM MR. MAX KOHL, of Chemnitz, we have received a catalogue (in German) of Röntgen ray and Finsen apparatus, high frequency apparatus, electric light baths, &c. It consists of 130 pages and is fully illustrated.

MESSRS. SIEMENS BROS. & CO., LTD., of York Street, Westminster, S.W., have sent us one of their binders in which to file the various leaflets, specifications which are issued by them from time to time relating to their specialities in connection with electrical plant. The lists already filed herein include specifications of their B. bipolar machines, F. plain open-type machines, and other generators and motors, including induction motors, also controllers and motor starters. Numerous diagrams of connections, lists of prices and excellent illustrations are given. This binding list will prove useful to the trade who make a practice of filing manufacturers' publications.

The IMPROVED ELECTRIC GLOW LAMP CO., LTD, of 7, Great Newport Street, W.C., have placed before us a copy of the fourth edition of their street-lighting catalogue. The preface contains a bold statement, claiming that every class of street lighting can be more efficiently and economically effected by means of arc and incandescent electric lighting than by any system of gas lighting. Some revised figures are given of the respective values of different illuminants, and the designs of posts, brackets, lanterns, and other fittings, have been brought up to date, though, of course, it is impossible to embody all the new designs that have been introduced.

The DIESEL ENGINE CO., LTD., of 179, Queen Victoria Street, E.C., has published a new illustrated catalogue, relating to its engines. Views appear of the 160 B.H.P. engines running at the Yardley depôt of the City of Birmingham Tramways Co., Ltd., an 80-H.P. at the Guildford electricity works, and larger sizes in use in works other than electrical. The leading particulars of the engine and its economy are detailed, together with performance data and curves. A table is given of standard sizes, from 20 to 500 B.H.P., with speeds, dimensions, weights, &c.

MESSRS. HUNT & HESS, of Litholite Works, The Grove, Hackney, N.E., have issued new sheets, Nos. 4, 5 and 6, showing Litholite bushes and handles, and giving current prices of same.

The LONDON ELECTRICAL FITTINGS CO., LTD, of Roberts Works, Hampstead Road, N.W., have issued a booklet showing their latest types of "L.E.F." electric radiators, including several new and pleasing designs.

A copy of their latest edition of No. 1 list of destructors has been received from the HORSFALL DESTUCTOR CO., LTD, of Leeds. It gives illustrations and particulars of some of the destructor plants erected by them, also clinker crushing and screening machines, mortar mills, small destructors for hospitals, domestic and trade refuse, &c. The destructors installed at the Fulham, Accrington, Batley, and some other electricity works are detailed. The company will send copies of the catalogue on application.

The ST. HELENS CABLE CO., LTD., of Warrington, has in circulation a variety of picture postcards illustrating the different departments in its works.

From Mr. G. BRAULIK, of 218, Upper Thames Street, E.C., we have received a show card and calendar, both giving prominence to the London Standard incandescent lamps, a speciality supplied by the firm.

MESSRS. G. CLARK & SONS, LTD., engineers, &c., of Shipley, Yorks, have sent us one of their wall calendars with tear-off monthly slips, for 1905. A diagram of the firm's patent universal "Bradford" disconnecting box is the chief feature of the card.

MESSRS. CHARLES MACINTOSH & CO., LTD., of 1 and 3, Golden Lane, E.C., are supplying the "W. & R." dry battery, of which they are supplying large quantities to the National Telephone Co., Ltd., and other firms. A price list has been issued.

A well-bound catalogue of electrical accessories has reached us from the ACCESSORIES MANUFACTURING CO., of 9 and 10, Wells Street, Oxford Street, W. Much care has evidently been given to

the arrangement of the matter in a clear and straightforward way, and, by means of a good thick paper and clear printing, the numerous illustrations are a success. Lampholders, lampholder adapters, tumbler and other switches, wall plugs, cut-outs, ceiling roses, distribution boards, counterweight fittings, main switches and many other accessories are set out, and prices of same are published.

MESSRS. NALDER BROS. & THOMPSON, LTD., of 34, Queen Street, E.C., have sent us one of their illustrated cards descriptive of their N.C.S. gold medal motor-gauge which has been recently placed upon the market.

A catalogue of "The Bristol" patent portable electric safety lamps and accumulators has been received from the BRISTOL ELECTRIC SAFETY LAMP WORKS, 40, Great Smith Street, S.W. Portable lamps for factory use, for miners, domestic, medical, carriage, photographic, and a variety of other purposes, and batteries for testing work, &c., are well shown and described, prices being also given.

Book Notices.—*Small Electrical Measuring Instruments.* London: Percival Marshall & Co. Price 6d. net.—Hardly a week goes by without our acknowledging in this column the receipt of one of the "Model Engineer" handbooks, which describe ingenious methods of making and using almost anything, from a battery to a steamship—on a small scale. The subject of this notice describes easy and economical ways of making detectors and galvanometers, a simple voltmeter, Wheatstone bridge, electroscope, &c., and explains in simple language the principles upon which they are based, and the modes of using them. There is nothing like *making* things for getting to know all about them, and we have no doubt that many a young engineer will derive great benefit from these little manuals.

Mathiesons' Handbook for Investors for 1905. F. C. Mathieson and Sons, 16, Copthall Avenue, E.C. 2s. 6d. net.—This is a most valuable little book for investors who want to know the Stock Exchange prices of the leading companies' securities for the past ten years, also the dividends. A separate section gives the details of electric lighting and some electrical manufacturing concerns.

Municipal Finance for Students. Gee & Co., 34, Moorgate Street, E.C. 2s. 6d.—The object of this work is to enable beginners in municipal accountancy to acquire a knowledge of the principles and practice of local government and its finance, not in order to launch the student out as a fully qualified financial officer, but to induce the reader to take up the further study of the points raised more thoroughly and seriously. Another object of the author, who is himself "A Municipal Accountant," is to enable anyone who has the consideration of municipal accounts to obtain a better understanding of them. Those who have such accounts before them know only too well that municipal accountancy manages to render its returns with a maximum of obscurity, so that the unpractised searcher after their truth often finds it impossible to understand them. If this little book helps to shed a little light in some of these dark places, it is well that it has been written. But what we all long for is more straightforwardness and uniformity in the preparation of the accounts themselves; that were better than a key to their interpretation. The author has not ignored the controversy that has been raging for some time past on the question of municipal *v.* private enterprise, the method of treatment adopted being the setting out of a number of anti-municipal trading arguments and the replies of the municipal man thereto. A chapter of special interest is that relating to the depreciation question, and three methods of treating the sinking fund are dealt with in some detail; the object of this chapter—which is one of the most timely in the book—is to enable the student to appreciate the points produced in the course of Press controversies on this question. Our own views on the matter of obsolescence and the inadequacy of sinking funds for meeting this are well known. The audit of municipal accounts comes in for some treatment. We have said sufficient to show that whatever the views of the reader may be on some of the debatable points referred to, he cannot but profit from sitting at the feet of "Municipal Accountant" for an hour or two.

A B C of the Differential Calculus. By W. D. Wansbrough. Manchester: The Technical Publishing Co. 1904. Second Edition. Price 3s. net.—This modest work, which has been styled by one of its readers as the "painless treatment for Differential Calculus," has been written with a view to revealing to the student the beauty and utility of the calculus without first terrifying and then disgusting him with unintelligible dissertations and unnecessary difficulties. The author has adopted a simple, conversational style, as though to conciliate and make a friend of the reader, and his explanations are so lucid and original that we were tempted to spend more time in reading them than we could spare for this brief notice. The ground covered in this work includes the ordinary rules for differentiation, logarithmic functions and trigonometrical ratios, inverse functions, successive differentiation, various curves, maxima and minima, with numerous examples in all cases. The book is well worthy of commendation.

"Etude Pratique des Courants Alternatifs Simples et Polyphasés et de Leurs Principales Applications Industrielles." Par Henri Chevallier. Paris: Librairie Polytechnique Ch. Beranger.

"Die Schwachstromtechnik in Einzeldarstellungen." Band I. Der Wahlweise Anruf in Telegraphen und Telephonleitungen. By J. Baumann. Berlin: R. Oldenbourg. M. 2.50.

"A Short Introduction to the Theory of Electrolytic Dissociation." By J. C. Gregory. London: Longmans, Green & Co. 1s. 6d.

"Lockwood's Builders', Architects', Contractors' and Engineers' Price-Book for 1905." By F. T. W. Miller. London: Crosby Lockwood & Son. 4s.

"Uber den Sogenannten Halleffekt in Elektrolyten." By Dr. Richard Heilbrun. Extract from the *Annalen der Physik.* Band 15, 1904.

"Widerstand und Stromverlauf." By Dr. Richard Heilbrun. Extract from the *Electrotechnische Zeitschrift*, Heft 51, 1904.

"Science Abstracts." Sections A. and B., No. 84, December 27th, 1904. London: E. & F. N. Spon. 1s. 6d. each net.

The January issue of the *Faraday House Journal* contains interesting articles on the "Artificial Lighting of Picture Galleries," and the "Best System of Alternating-Current Traction for Long-Distance Lines," as well as descriptions of engineering works associated with Faraday House. The college is moving to Southampton Row at Easter.

Bankruptcy Proceedings.—On 5th inst. John Hill, electrical engineer, Glasgow, was examined in bankruptcy before Sheriff Balfour. Bankrupt attributed his insolvency to the lack of capital. The state of affairs showed liabilities £1,981 17s. 6d., and assets £165.

Point Controllers.—Messrs. S. Dixon & Son, Ltd., of Leeds, have received an order from the Rotherham Corporation Tramways Department for the installation of Turner's automatic point controller.

Trade Announcements.—We understand that the Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury Works, Bradford, have opened an office as from the 1st inst. at 17, Victoria Street, Westminster, and this will be in charge of Mr. E. W. T. Ward, who has recently joined their staff as London representative.

Messrs. Andrew Brown & Co., of 110, Cannon Street, E.C., have been appointed the London and district agents for Messrs. Penman and Co., boilermakers, Glasgow.

On and after 21st inst. the address of the Britannia Rubber and Kamptulicon Co., will be 9, Bradford Avenue, Redcross Street, E.C., the old premises having been acquired by the L.C.C. for a fire station.

Messrs. Balcke & Co., condenser specialists, of 27, Clements Lane, E.C., have opened a new branch office at Imperial Chambers, Albert Street, Derby, for the Midland and South Yorkshire District.

Dinners.—Having concluded two large electric light installations at Ipswich—viz, the Cliff Brewery and the Co-operative Society's premises in Carr Street—Messrs. Tamplin and Makovski, Ltd., of Northgate Street, entertained their employés to a dinner at the White Horse Hotel on Tuesday last week. Mr. J. Drayson Dymond, the local manager, presided.

On January 2nd the first annual dinner of the outside staff of the National Telephone Co., Newcastle district, was held at the Turk's Head Hotel, Gateshead. There were close upon 60 present. The chair was occupied by Mr. R. Palmer.

The eighth annual dinner of the North Staffordshire Railway electrical staff was held at the Borough Arms Hotel, Newcastle, on Saturday last, Mr. A. F. Rock presiding.

Dissolutions and Liquidations.—The New Zealand Electric Light and Traction Co., Ltd., is winding up voluntarily, with Mr. R. W. Blackburn, 35, New Broad Street, E.C., as liquidator.

Messrs. G. V. Llewelyn and E. M. Ashley (Southport Electric Lighting Co., 189, Lord Street, Southport) have dissolved partnership. Mr. Ashley will attend to debts and will continue the business on his own account.

The British Columbia Telephones, Ltd., is winding up voluntarily with Mr. Maurice Brewer, 49, Queen Victoria Street, E.C., as liquidator. A contract for the sale of all the assets to Dr. John Matthew Lefevre has been approved.

Messrs. W. H. R. Saunders and W. E. O. Williams (J. P. Saunders and Co., telegraphic and electrical engineers, of Westminster and Cardiff) have dissolved partnership. Mr. Saunders will attend to debts relating to the telegraphic, telephonic, and general electrical business, and will continue to carry on that business under the old style with Messrs. J. H. P. Berthon and S. G. Leech, as new partners. Mr. Williams will attend to debts relating to the electric light and electrical engineering parts of the business, and will continue under the style of W. E. O. Williams & Co., at 29, West Bute Street, Cardiff.

Boiler Litigation Settled.—We learn that the Stirling Boiler Co., Ltd., and the Stirling Co., of U.S.A., have come to an arrangement, whereby litigation which had been pending between the two companies for nearly a year has been satisfactorily settled. We understand that the Stirling Boiler Co., Ltd., have acquired all the British and European patents of the American Co., and in future all boilers sold in these markets will be of British manufacture. The Stirling Boiler Co., Ltd., are well equipped for dealing with a large volume of trade. They have large works at Motherwell, in the heart of the steel making industry of Lanarkshire. We understand, further, that both the American 4-drum type and the British 5-drum Stirling boiler will be sold in this country.

LIGHTING AND POWER NOTES.

West Hartlepool.—The T.C., on the recommendation of its E.L. Committee, has authorised the electrical engineer to obtain tenders for an additional 250-KW. set, with the necessary switchboard, &c., and resolved to apply to the L.G.B. for sanction to borrow £2,200, the estimated cost of the addition. The electrical engineer stated that the whole of the plant now installed, with the exception of a single 100-KW. set, had been in use for the last two months.

(*Continued on page* 65.)

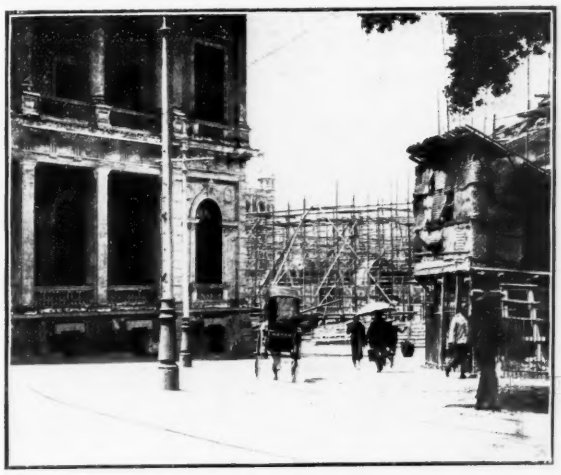
ELECTRIC TRAMWAYS IN HONG KONG.

Since the island of Hong Kong became a British possession, rather more than 60 years ago, its rise in importance, as our chief commercial centre and naval stronghold in the Far East, has been both rapid and unique.

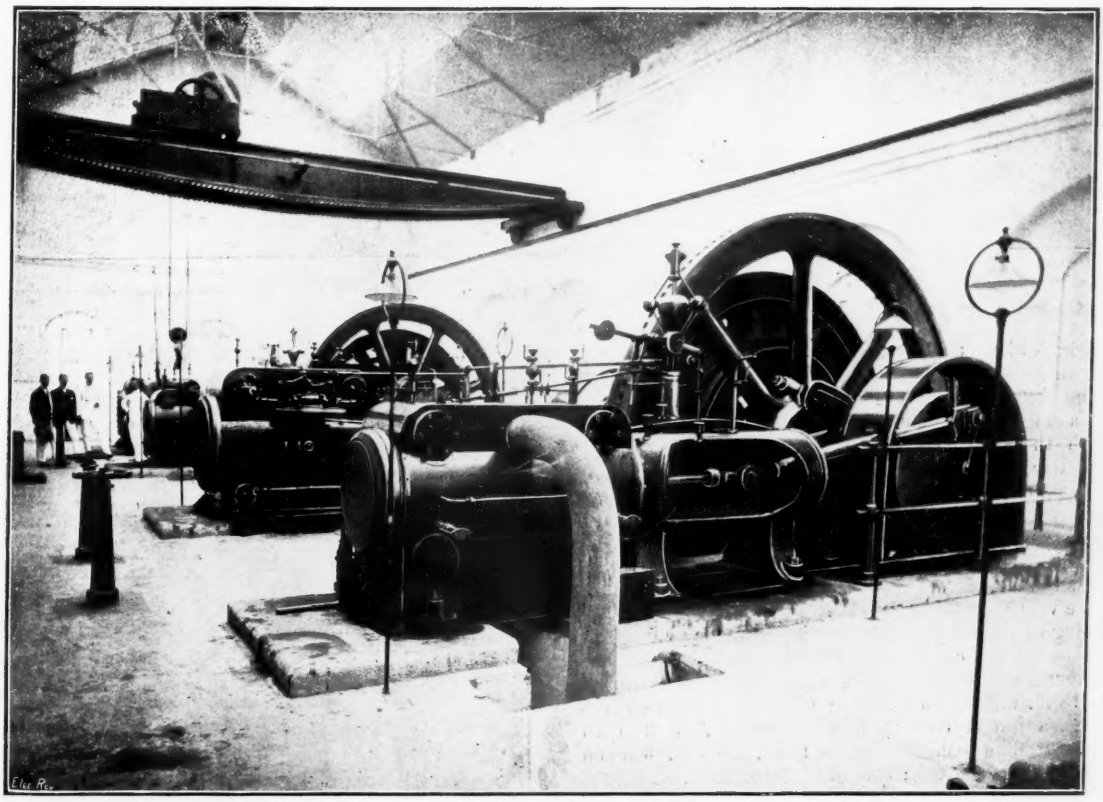
Situated near the mouth of the Canton river, and distant about 90 miles from the ancient Chinese city of Canton, it possesses one of the finest and most beautiful natural harbours in the world. This must have been recognised by the Chinese themselves hundreds of years ago, as the Chinese characters representing the name of the island signify "good harbour."

The island itself is some 11 miles long, and from 2 to 5 miles broad, and consists mainly of lofty uncultivated hills. In the younger days of the Colony it was considered a most unhealthy place owing to the prevalence of malaria, but to-day the efforts of the Sanitary Board on the one hand, and the Afforestation Department on the other, have completely removed this reproach.

During the summer months the humidity of the atmosphere renders the heat very trying to Europeans, but from September to March the weather is all that could be desired. The population of Hong Kong is estimated at 325,600, and of these 307,000 are Chinese. Its trade is estimated at £20,000,000 per annum. It has excellent dock accommodation, is strongly fortified, and is our permanent Naval base in the Far East.



View of Sharp Curve.

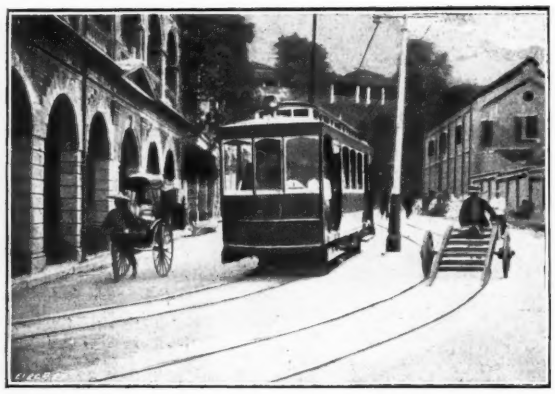


Interior of Engine Room.—Yates & Thom—Dick, Kerr Steam Dynamos.

In 1902 an ordinance was passed by the Legislative Council of Hong Kong, authorising the tramways to be laid down by the Hong Kong Tramway Electric Co., an English company with its headquarters in London; the work was commenced in May, 1903, and was completed last July. The detailed plans and specifications were prepared by the company's consulting engineers, Messrs. Alfred Dickinson & Co., of Birmingham, who appointed Mr. Harold Hackwood to act as their representative in Hong Kong, as resident engineer in charge of the construction. The contractors were Messrs. Dick, Kerr & Co., Ltd., of London, who carried out the whole of the work.

The total length of single track is 14½ miles, which is

laid in 9¼ miles of route. The track is laid to a gauge of 3 ft. 6 in., with rails of the girder type weighing 86 lb. per lineal yard. Each rail joint is double-bonded with 6/0 S.W.G. copper bonds.

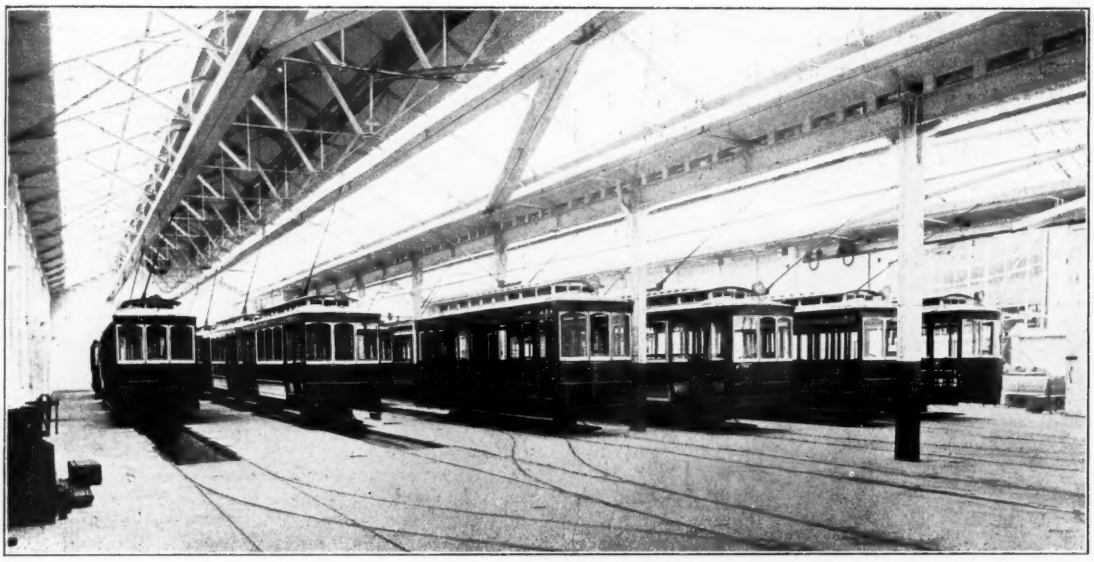


Combination Car on Line, in Arsenal Street.

The overhead construction has been carried out in a very neat manner, the length of arms on the centre poles not exceeding 2 ft., while the arms on the side poles vary in length, the majority of them being 6 ft. long. The poles are of mild steel 28 ft. 3 in. in length, 7 in. in diameter at the base, and tapering to 4 in. in diameter at the top. They are set 6 ft. in the ground in a solid block of concrete. Within the city, ornamental base castings greatly add to the appearance of the poles, which is still further improved by the addition of wrought-iron scrolls on the bracket arms.

The trolley wire is divided into half-mile sections by means of section insulators, and at each of these points the main feeder cables are tapped and current is taken to supply each section of trolley wire; this is accomplished by running the feeders through a feeder pillar containing the necessary switches and fuses. The connections from the feeders to the trolley wires are made with rubber-covered 37/16 cables, carried up inside the poles and along the sides of the bracket arms. The pressure on the trolley wire is 500 volts. A lightning arrester is provided in each feeder pillar, and also a telephone giving direct communication with the power house.

The feeder cables were supplied by Messrs. Callender's Cable and Construction Co., and were laid on the solid system. In addition to the main feeders running east and west from the



Interior of Car-shed.

The lines within the City of Victoria are laid for the most part with centre-pole construction, but the Eastern portion of the route, being outside the city boundary, is laid as single line with passing places, and is equipped on the side-pole system.

With the exception of a short branch line, which runs to the Race Course, the route runs parallel with the sea front, and, except in the case of a short length at Quarry Bay, is practically level. At Quarry Bay a small amount of road-grading has been done, the original grade of 1 in 10 having been reduced to 1 in 15. Beyond Quarry Bay is the Eastern terminus of the line, where is situated the small Chinese village of Shankiwan.

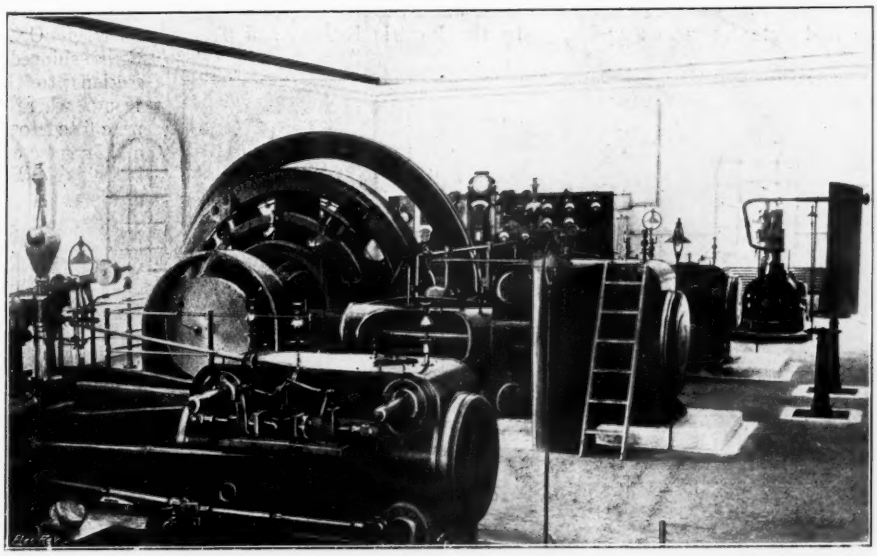
Owing to the varying nature of the ground, three forms of permanent way construction have been adopted. Where the ground was solid the rails were bedded on a concrete beam 18 in. wide and 6 in. deep; where the ground was not so good, a bed of concrete 6 in. deep and 7 ft. 3 in. in width, extending under the whole track, and 1 ft. 6 in. on either side, was adopted; over doubtful ground, which had been recently reclaimed from the sea, this concrete bed was increased to 8 in. in depth. The concrete used was mixed in the proportion of 6 : 1, Portland cement of local manufacture and exceptionally good quality being used. After the rails and the bottom concrete were laid, the road surface was made up to rail level with concrete and finished off with a smooth surface to the proper camber of the road.

View in Des Voeux Road West.

power station, a return 37/13 booster feeder has been laid in each direction to within a mile of the two distant termini, where it is connected to the rails; it also makes connection with the rails at each feeder pillar. A three-core pilot cable

has also been laid from the power station to each terminus, one core being connected up for testing purposes, and the remaining two cores being used for telephone service.

The generating station is as nearly as possible in the centre of the system, a convenient site having been obtained alongside the Bowrington Canal, from which water for condensing purposes is obtained, and which enables coal and materials to be delivered by barges direct on the site. The only objection which could be found to the site lay in the fact that a very few years ago it was reclaimed from the sea, and consequently no good foundation could be obtained for either buildings or machinery; however, as it was the best site obtainable in all other respects, this difficulty had to be overcome, and efficient foundations were obtained by the driving of over 5,000 piles. These were spaced so as to support the whole weight of the buildings by themselves, the ground, which greatly varied in solidity, being left as an additional factor of safety. China fir piles, 15 ft. in length and 5 in. in diameter, were used for the buildings and machinery, special 7-in. piles, 18 ft. in length, being used for the chimney foundations.



View of Generating Set, towards Switchboard.

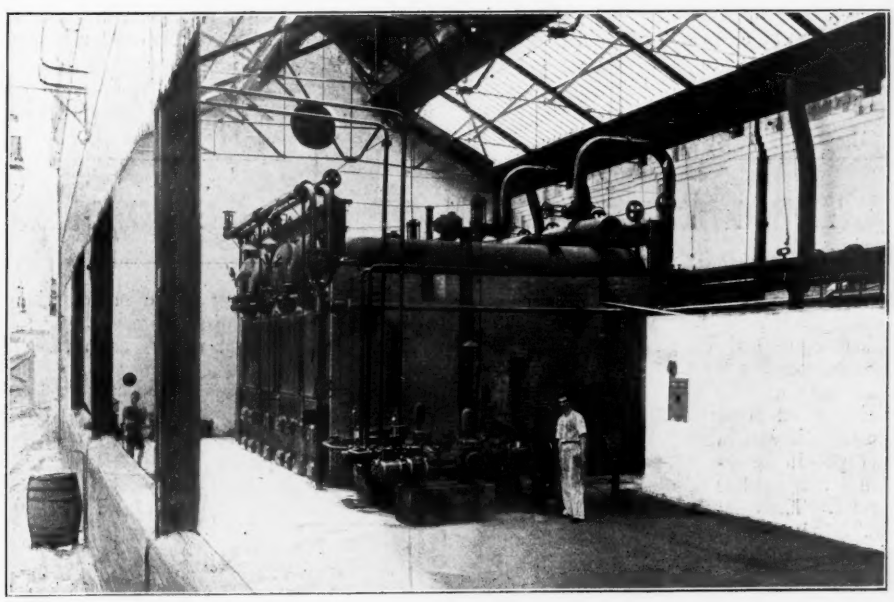
The depôt comprises engine room and basement, boiler house and coal store, car-shed and machine shop, smithy, paint shop and carpenters' shop, and also offices.

The engine room, which is lofty and well lighted, contains two Dick, Kerr continuous current, direct connected railway generators, of the multipolar type, compound wound, giving a pressure of 550 volts, and running at 100 revolutions per minute. They are designed to run either separately or in parallel. The generators are keyed direct on to the main shafts of the engines, which are of the horizontal cross-compound type, each engine being equal to a maximum load of 557 B.H.P. The engines, built by Messrs. Yates & Thom, are each provided with a Wheeler surface condenser of the Admiralty pattern, and may be worked either condensing or non-condensing. The condensers are fixed in the basement below the engine room, as also are all the steam and other pipes, thus leaving the engine room free and open. Circulating water is obtained for the condensers from the Bowrington Canal, which runs alongside the site, the water first passing through sumps fitted with gratings and strainers to exclude obstructions.

In addition to the two traction sets, there are two smaller sets for the arc and incandescent lighting of the depôt, one set being driven by a small high-speed engine, and the other by a motor running on the 500-volt circuit. The lighting circuit is supplied at 100 volts pressure.

The switchboard, which is of Messrs. Dick, Kerr's standard type, consists of nine panels. It includes a main station panel, two generator panels, two feeder panels, one panel of the Board of Trade type, and three lighting panels. The main station panel contains recording instruments of the latest pattern, including an integrating wattmeter showing the total output of the station. The Board of Trade panel is arranged for receiving test wires from different parts of the line, and is provided with instruments for making all the tests prescribed by the Board of Trade.

An overhead travelling crane is provided, capable of lifting and traversing in any direction a load of 10 tons over the whole area of the engine room.



B. & W. Boilers and Green Economiser.

The boiler house, which is at a lower level than the engine room, contains two double-drum water-tube boilers of Messrs. Babcock & Wilcox's make, arranged to burn ordinary Japanese engine slack. Each boiler has 3,654 sq. ft. of heating surface, evaporates 12,000 lb. of water per hour, and works

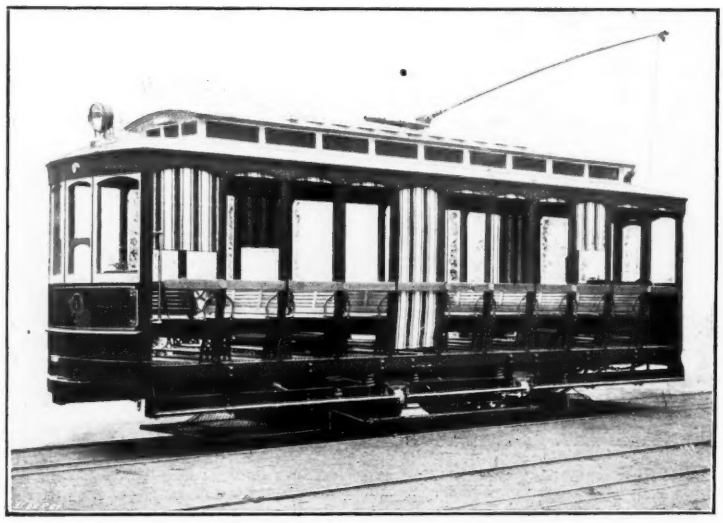
at a pressure of 160 lb. per sq. in. In addition to the steam and water gauges, each boiler is fitted with a spring safety valve and a dead weight safety valve. Water is supplied to the boilers by two Blake & Knowles feed pumps, which take water from either the storage tank or the hot well, and feed the boilers either direct or through a Green economiser. In case of mishap the economiser may be cut out, the flue gases being conveyed to the chimney by means of a bye-pass or auxiliary flue, and the feed water being pumped direct into the boilers without passing through the economiser tubes. Two feed water filters are supplied, and all the feed water passes through one or other of these before entering the boilers.

The chimney, which is circular in section, is built of brick and is 153 ft. in height. As Chinese bricklayers are unaccustomed to this class of work, it presented greater difficulties in construction than any other part of the work, and as Hong Kong is subject to typhoons of great severity, exceptional care had to be taken with both the foundations and the building of the shaft. With the exception of the foundations and the chimney cap, the whole of the brickwork is built in lime mortar of special composition, as is also the brickwork of the buildings.

The car-shed, which is a rectangular building 220 ft. in length, contains six lines of track and gives accommodation for 35 cars. The roof is of iron, in two spans, partly glazed and provided with louvres, giving plenty of light and ventilation. Inspection pits run the whole length of the shed.

There are 26 single-deck motor-cars, ten being of the combination type, with an enclosed portion in the centre and an open platform provided with seats at either end. The remaining 16 cars are of the open cross-bench type. The overall length of the cars is 29 ft., the total width is 6 ft. 6 in., and the wheel base 6 ft. 6 in. The combination car has a seating capacity for 32 passengers, and the cross-bench car for 48 passengers. Each car is mounted on a truck of the Brill type, and is equipped with Dick, Kerr 25 A motors, with their standard metallic shield blow-out controllers and the usual hand brakes.

The trolleys, which are of the lateral type and are provided with a swivel head, are 16 ft. 6 in. in length, and enable the trolley wire to be fixed 10 ft. away from the centre of the track where necessary. The car bodies were built at Preston by the Electric Railway and Tramway Carriage Co., and were shipped in sections to Hong Kong, where they were fitted together and connected up in a very short space of time.



Cross-Bench Car.

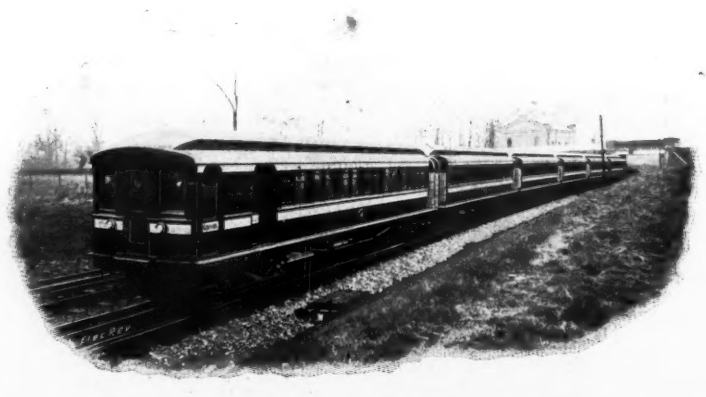
At one end of the car-shed is a well equipped workshop, containing screw-cutting gap-lathe, wheel lathe, wheel press, and drilling machines, the whole being driven by a 500-volt motor. A suitable smithy, carpenters' shop, and paint shop are also provided.

Before the introduction of electric traction into Hong Kong the popular ricksha, drawn by a Chinese coolie, was the principal means of locomotion, and of these nearly 2,000 were licensed for hire, in addition to a large number owned privately. Although rather slow, the ricksha is hard to beat for general convenience; the fight for supremacy between the out-of-date ricksha and the new electric car will be of interest, but must of necessity end in the victory of the latter.

Besides the system above described, Messrs. Dick, Kerr and Co. are also constructing an electric tramway in Tokio, Japan; and we trust that many other important undertakings in the Far East will fall to the lot of our British engineers and manufacturers in the near future.

THE ELECTRIFICATION OF THE METROPOLITAN RAILWAY.

We recently reported the semi-public inspection of the new electric service of the Metropolitan Railway Co. between Baker Street and Uxbridge, and on New Year's Day, as foreshadowed by the chairman of the company on that occasion, the system was put in operation for public service. The company is to be heartily congratulated upon the inauguration of the new *régime*, which, we hope, when extended to the rest of its system, will prove to be amply justified by the increase in the traffic, in the comfort and convenience of the travelling public, in the ratio of receipts to expenses, and in the company's prosperity ensuing therefrom.



Six-Coach Electric Train on the Metropolitan Railway.

As our readers are aware, the Metropolitan and Metropolitan District Railways are to be worked by direct current, obtained from rotary converters in sub-stations, the power being transmitted to these in the form of three-phase alternating current at 11,000 volts, 33⅓ cycles per second. In both cases the power plant is being manufactured and supplied by the British Westinghouse Co., Ltd., and the special

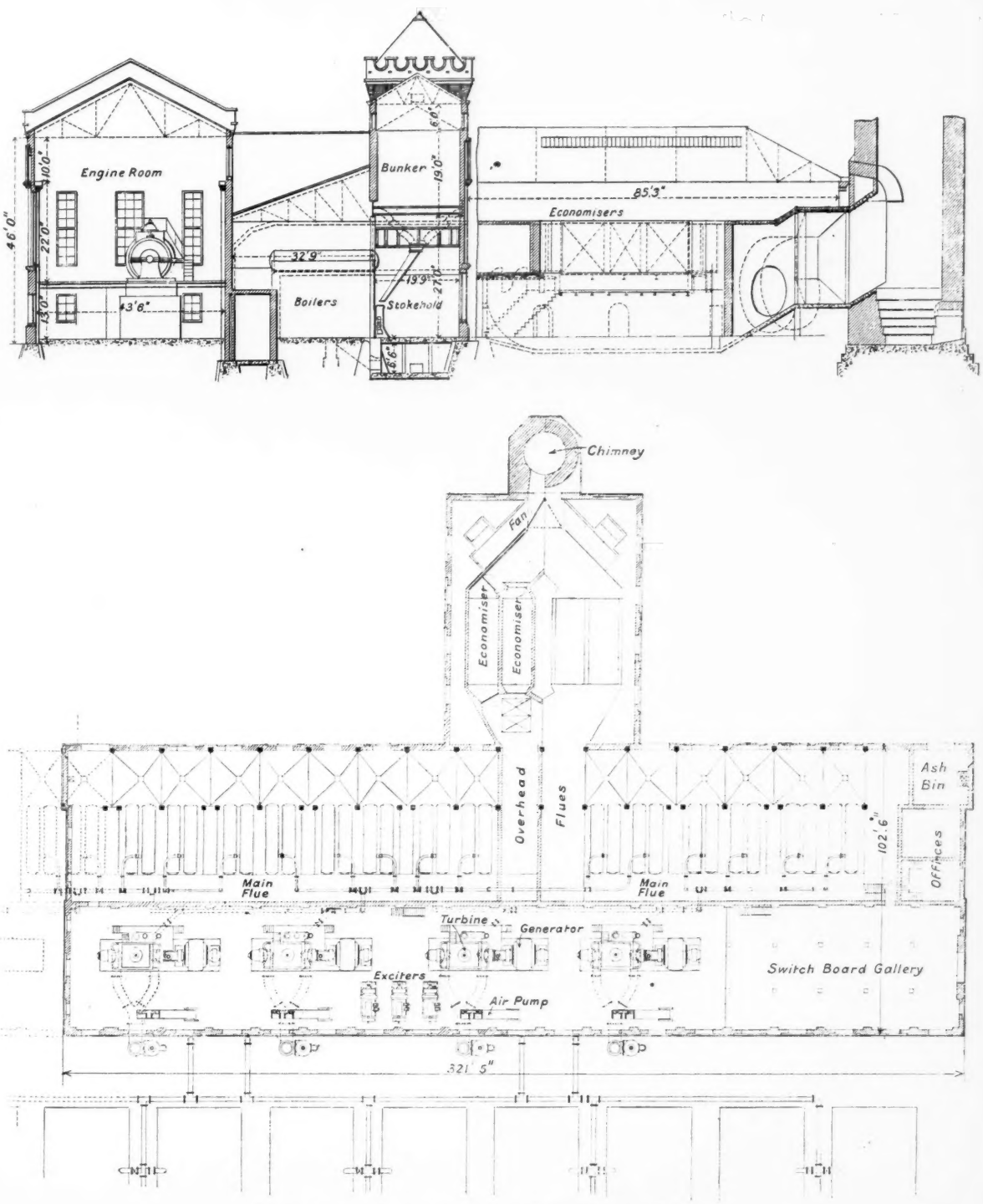
feature of both undertakings is the adoption of Westinghouse-Parsons steam turbo-alternators for the whole of the generating plant, on a larger scale than in any other undertaking in existence. The following description of the plant will therefore be of interest to our readers.

The Metropolitan Railway Co.'s generating station is situated close by the company's locomotive and engineering works at Neasden. This site provides plenty of room for extension, gives every facility for coaling, and is very centrally situated as regards the company's sphere of operation. An abundant supply of water for boiler feed and all other purposes has been found at a depth of over 400 ft., and two artesian wells have been sunk to tap it.

The main building of the power station is 327 ft. long × 101 ft. wide, covering an area of 3,570 sq. yds. This makes it one of the largest stations in the world owned by a single railway company.

The accompanying plan shows that the main building is divided longitudinally into two parts, the larger of which is the boiler room, measuring 321 ft. long × 53 ft. wide. It contains 10 Babcock & Wilcox water-tube boilers, each of 5,730 sq. ft. heating surface, fitted with Babcock superheaters and Roney mechanical stokers; the latter are driven through gearing by Westinghouse vertical enclosed engines. The boilers are guaranteed to evaporate 20,000 lb. of water each per hour, working at a pressure of 180 lb. per sq. in., and a superheat of 180° F.

Coal is brought to the works by means of a special siding,



SECTIONAL ELEVATION AND PLAN OF NEASDEN POWER STATION.

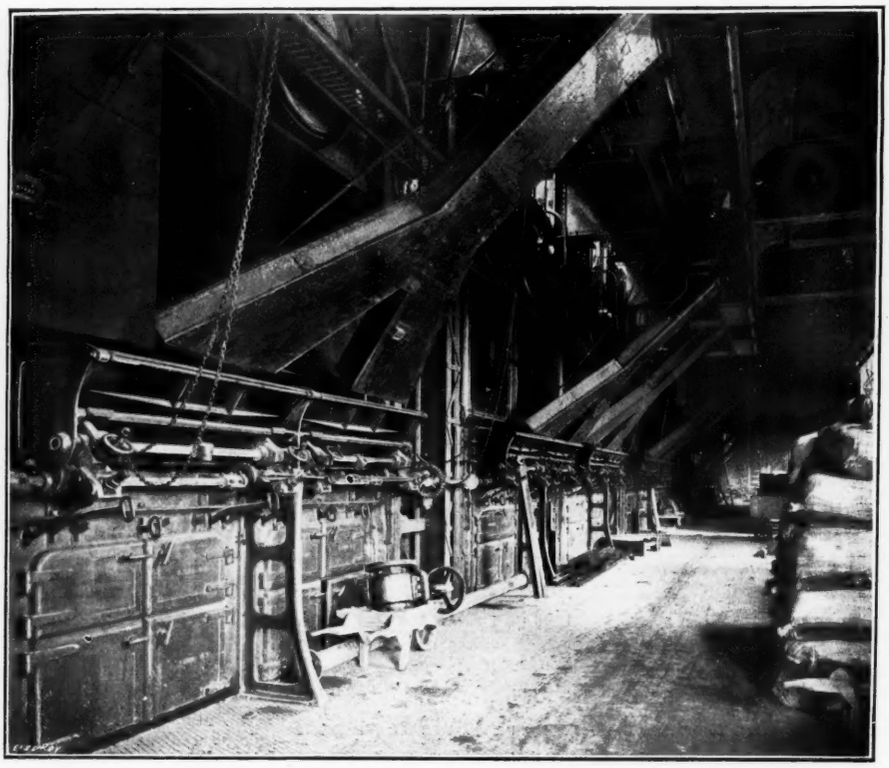
the trucks delivering the fuel into a large hopper at the eastern end of the boiler house. From this it is carried through crushers, which break it up to the required size and pass it, by means of a bucket conveyor made by Messrs. Graham, Morton and Co., Ltd., to the storage bunkers above the boilers. From thence it falls by gravity to the individual stoker hoppers, being automatically weighed *en route* by Avery machines. The same conveyor is also arranged to remove the ashes, which are discharged into a special bin.

The two economisers at present installed, the scrapers of which are driven by three-phase motors, are of Messrs. Green's well-known make, each having 1,760 tubes. They are situated in a chamber divided into two parts, each of which is provided with its own engine-driven induced draught fan. The chimney, which is 200 ft. high and 15 ft. in diameter, is approached by a flue 28 ft. wide, divided into two by a brick partition. The arrangement of the overhead flue and economisers is shown in the accompanying plan and elevation of the station. (p. 61.)

The portion of the engine room actually devoted to the generating machinery is 233 ft. 9 in. long × 43 ft. 6 in. wide; in addition to this, at one end is the space devoted to the switchboards, transformers, and other auxiliary electrical apparatus.

The generating plant at present consists of two 5,000-B.H.P. Westinghouse steam turbines, coupled to 3,500-KW. three-phase Westinghouse alternators, and two more similar sets will shortly be installed. The turbines are of the multiple-expansion double-flow type, with a guaranteed steam consumption of not more than 17 lb. at full load, and 20¼ lb. at half-load, per kilowatt-hour, the steam being superheated to 180° F., and supplied at a pressure of 180 lb. per sq. in.

Exterior of Neasden Power Station.



Boiler House, showing fronts of Roney Stokers, and Coal Shoots.

These machines represent the latest practice in every detail, particularly in the reduction in length; this has been achieved by an increase in diameter, which constitutes an important advance in steam turbine construction. They have passed successfully through all their trials, and, beyond the infantile ailments that new machinery always suffers from, have given no trouble. Despite the size, their freedom from vibration is remarkable, and only the least tremor can be felt on applying the hand to the casing. The prominence that this type of prime mover has recently attained in heavy electrical work may make some details of its operation interesting, particularly as the Westinghouse turbine differs in many respects from others.

The rotating drum is of rolled steel, fitted with forged steel umbrella-shaped disks shrunk into each end. These grip the steel shaft, which is pressed into them, and the whole results in a very strong, though light, arrangement. The blades are dovetailed and caulked into grooves cut in the periphery of the cylinder, and in the case of the low pressure series are of special metal in order to avoid the corrosive action of wet steam.

The bearings are of the spherical type, of cast-iron with Babbitt metal linings.

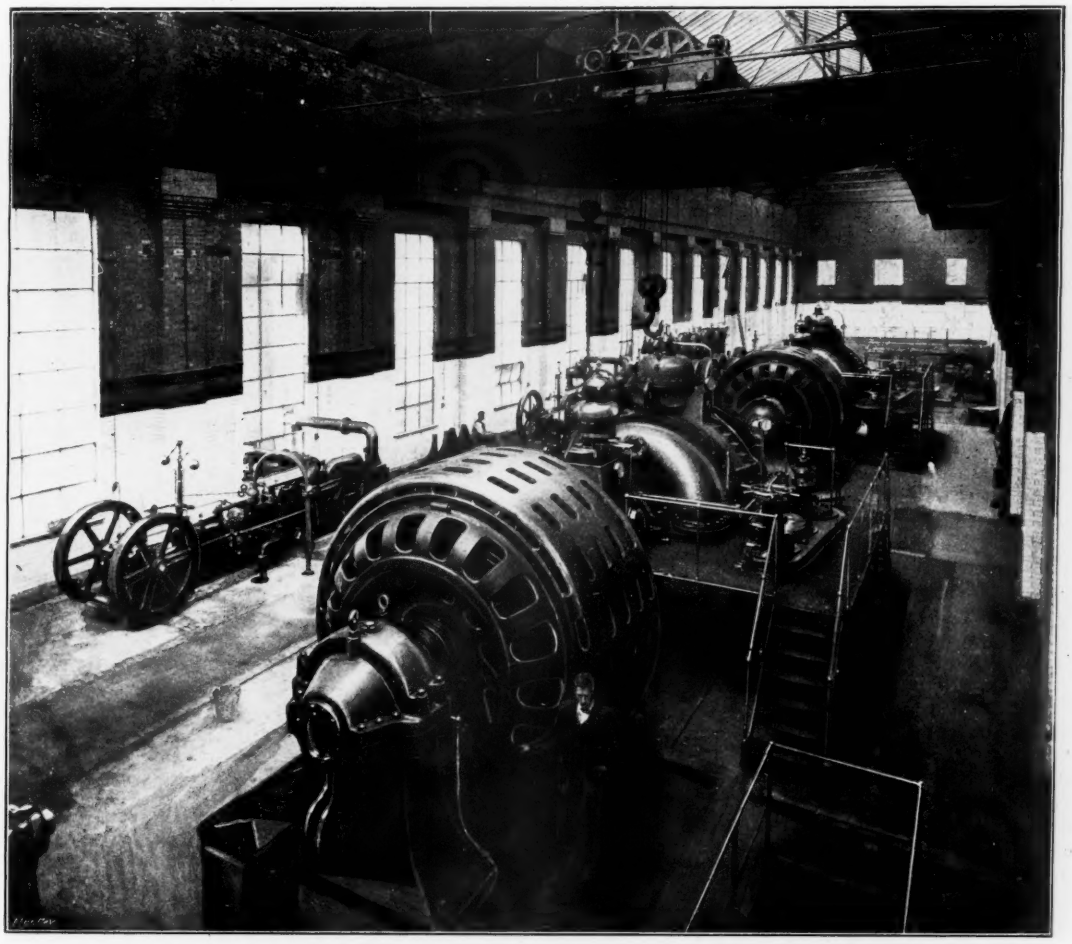
The flexible claw couplings for connecting the turbine rotors with those of the alternators are of forged steel and run in oil, and they are arranged to allow for any inaccuracy in the alignment of the two shafts. The operation of the valve gear is best understood by following the course of the steam through the turbine. Starting at the main stop valve, which is of the disk type, and is operated from the platform by means of gearing, the steam flows through an emergency valve, strainer, and double-seated poppet type governor valve, actuated by a centrifugal governor and steam relay, into the cylinder at the centre. It now passes through a series of nozzles and impulse blades, and expands down to approximately atmospheric pressure, after which its course lies through a number of pressure blades on the Parsons principle to the condenser.

Interior of Economiser House.

The system of admitting steam at the centre with an equal flow each way, instead of at one end, keeps the shaft in perfect equilibrium, and entirely does away with end thrust, and therefore with balance pistons. A thrust block is fitted at one end to allow of longitudinal adjustment of the rotating drum.

Lubrication of the turbine sets is effected from a central system which supplies oil under pressure to each bearing, in separate pipes.

The three-phase generators are mounted on a continuation of the turbine bedplate. The output per phase on a non-inductive load is 184 amperes at 11,000 volts, and the guaranteed efficiency is 96·5 per cent. at full load, 95·5 per cent. at three-quarters, and 93·75 per cent. at half-load.



Westinghouse-Parsons 3,500-kw. Turbo-Alternators.

The speed is 1,000 r.p.m., and as the rotating field of the alternator has four poles, the frequency is 33⅓ cycles per second.

The exciting current is as usual led to the field coils by the aid of slip rings. It is derived from two exciter units, each of which consists of a Westinghouse single-acting compound engine, running at a speed of 275 r.p.m., direct coupled to a 100-KW. 125-volt D.C. compound-wound generator. One such unit is sufficient to supply all the generators with exciting current at full load.

Barometric Condensers, and Cooling Towers.

Wherever possible, induction motors have been employed for driving auxiliary plant, such as economiser scrapers, coal and ash conveyors, &c. They are operated from a special three-phase 440-volt generating set of 100-KW. capacity, which is driven by a direct-coupled single-acting compound Westinghouse engine. As an alternative source of power for this purpose, four 50-KW. transformers are installed, connected through oil switches to the high pressure switchboard bus-bars.

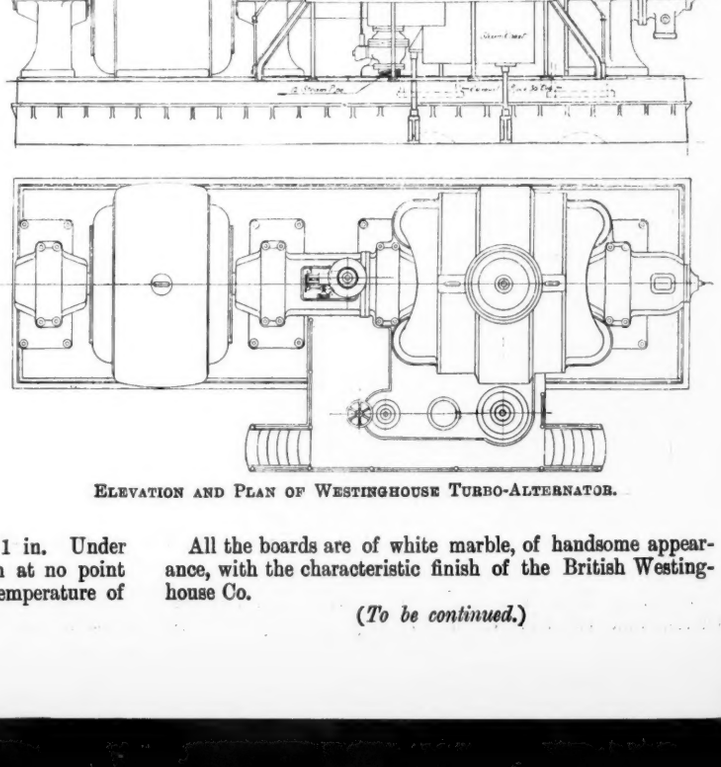
The condensing plant is of the barometric type, and was made by the British Westinghouse Co. at their Trafford Park works, to the designs of the Alberger Condenser Co. This is a form of condenser that is little used in England; it was chosen because it is particularly well adapted for maintaining the high vacuum at all loads that is such an important feature in the economical working of the steam turbine. Condensers are installed for each main generating unit, and they are separately capable of dealing with 66,500 lb. of steam per hour at normal full load, and 110,000 lb. per hour at maximum overload for a period of one hour. At normal load, a vacuum of 27 in. is attained, and the above overload reduces this only by 1 in. Under the former condition the velocity of the steam at no point exceeds 270 ft. per second, or the maximum temperature of the circulating water 85° F.

A steam-driven rotative dry vacuum pump is provided with each condenser, and its engine when working at full load develops 55 H.P., with a steam consumption of 1,375 lb. per hour. By what is termed the two-stage arrangement of this pump, it is enabled to produce a vacuum of 29 in. in the condenser when this is shut off from the engine. The chief feature of this two-stage method is that it makes it possible for the condensing plant to maintain a very high vacuum at all loads, even with a temperature of the circulating water considerably exceeding the normal.

In addition to such other auxiliary plant as has been previously mentioned, there are installed three 18-in. centrifugal Gwynne cold water circulating pumps, each driven by a Westinghouse compound engine; three 16-in. Worthington hot water circulating pumps, each driven by a similar engine; two surface feed heaters, each containing 1,000 sq. ft. of heating surface; one Alberger surface condenser, of 700 sq. ft. cooling area, for condensing the exhaust steam from the exciter engines and the 100-KW. auxiliary generating set; two Cole, Marchent & Morley grease extractors; two tandem compound Weir steam feed pumps; six cooling towers, erected by Messrs. Donat & Co., each capable of cooling 400,000 gallons of water per hour; two 20-ton overhead electric travelling cranes, by Messrs. Higginbottom and Mannock, fitted with Westinghouse motors; and one Harris patent feed water softener, capable of effectively dealing with 13,000 gallons of cold water per hour.

The position of the switchboard is shown in the plan on p. 61.

As the pressure of the current controlled by this switchboard is 11,000 volts, fireproof construction, safety and convenience of working have been the leading considerations in its design. The bus-bars and other conductors are supported on heavy porcelain insulators, and where a difference of potential exists, are separated by means of fire-proof and insulating walls. All conductors are placed so as to offer the least risk to the switchboard attendants, but, at the same time, they are arranged so as to be readily accessible if necessary, and fully in sight. In the lower gallery the 11,000-volt generator and feeder main circuit oil switches are placed; and in the gallery above them are the selector switches. The top gallery contains the main A.C. bus-bars, and the various instrument and control boards.



Elevation and Plan of Westinghouse Turbo-Alternator.

All the boards are of white marble, of handsome appearance, with the characteristic finish of the British Westinghouse Co.

(To be continued.)

LIGHTING AND POWER NOTES.

(*Continued from page 56.*)

Australia.—The Municipal Council of the Sydney suburb of Newton has decided against accepting an offer made by Messrs. G. B. Edwards and C. G. Hatte to light the borough by electricity.

Blaydon-on-Tyne.—The County of Durham Electrical Power Distribution Co. has written to the U.D.C. asking whether there is any possibility of the Council making an arrangement whereby the ratepayers of the district may have a supply of electrical energy under the Council's E.L. order. The letter stated that a working arrangement had been made with the Priestman Power Co. which would enable the E.P.D. Co. to carry out the terms of the order. The matter was referred to the Electrical Committee.

Bradford.—At a meeting of the Bradford Electricity Committee on the 6th inst. a report from Mr. A. P. Trotter, electrical adviser to the Board of Trade, was presented on the recent breakdown. This largely endorses that made by Mr. A. S. Blackman. The chief causes of the breakdown, in Mr. Trotter's opinion, appear to have been that—

1. The lead sheaths of the cables are not electrically continuous across the joint boxes.
2. Leakage currents have been allowed to pass and appear to have been undetected, or, if detected, they have not been localised or removed.
3. No fuses have been provided.
4. No arrangements have been made for preventing an extensive stoppage of supply.

The Inspector adds that the general regulations respecting leakages and their localisation appear to have been neglected, and recommends what has already been advised—the reorganisation of the distributing system, and the splitting of it into sections, with separate fuses and circuit-breakers, and improvements in the main switchboards.

The Electricity Committee proposes to purchase a motor-car at a cost of £325 for the use of the department, which, it is stated, will effect a considerable economy on the present arrangements.

Bridgend.—The list of duties in connection with the advertisement of the U.D.C. for the appointment of working electrician at £130 per annum, in connection with the electric lighting undertaking, is as follows:—

Applicants must be able to make joints on concentric lead-covered and armoured cables for house connections, and for other purposes.
Test and inspect electric light installations, attend to and make repairs on arc lamps, and other electrical fittings.
Do the necessary technical book-keeping and correspondence.
The man engaged by the Bridgend Urban District Council must give his whole services to the Council, and will be required to carbon, clean and generally attend to 15 arc lamps and about 150 incandescent electric street lamps.
Also make house connections, extensions to the mains, test and inspect electric light installations connected to the private lighting mains.
Fix, read, and test meters, when necessary, and generally perform the duties of working electrical engineer to the Council.
He will also have to "switch on" and "switch off" the arc and incandescent lamps. He will also have to keep the necessary books of record, &c., in connection with the undertaking, and conduct the general correspondence relating thereto.
When necessary the Council will provide unskilled labour in connection with any of the works that the engineer will be required to do.
Electrical energy being taken from the South Wales Power and Distribution Co., there will be no running machinery to be attended to nor any regulation of pressure.
The appointment is subject to two months' notice on either side.
Copies (not originals) of testimonials must be sent and will not be returned. No question will be answered by post. Applicants must be content with the above particulars.

We gather that 300 applicants are thirsting to work 24 hours in a day. Who will be the lucky man?

Bristol.—A failure of the electric light supply took place over the Broadmead area shortly before 9.0 p.m. on 10th inst., putting the G.P.O., numerous shops, &c., into darkness. Supply was, however, restored in less than half-an-hour, though much inconvenience was caused.

Bury (Lancs.).—The T.C. has resolved to oppose the application of the Lancashire Electric Power Co. for a prov. order to enable it to supply energy to Tottington.

Cheltenham.—The T.C. has authorised Mr. Swinburne to negotiate with the Light Railway Co., with a view to arranging the charge for traction by agreement, if possible, without going to arbitration. The borough electrical engineer has been granted four weeks' leave of absence in consequence of ill health.

Chertsey.—At the meeting of the U.D.C. on January 3rd, a deputation from the local E.L. syndicate attended and explained a scheme of electric lighting. It is proposed to form a small company to light the town by electricity with the consent of the Council, without first obtaining a prov. order through the B. of T., thus saving the expense of getting superior powers. Capital to the extent of £3,500 had been promised, and that was deemed to be sufficient for a start. With regard to the application of the Woking Co. for a prov. order, which the Council is supporting, it was pointed out that that company could not apply for powers until July, and if the Council consented to the present proposal the work would be well in hand by that time. The proposed charge was 6d. per unit, and a licence for 21 years was sought. The Council decided not to assent to the proposal.

Chingford.—The U.D.C. has resolved to oppose the application of the Charing Cross and Strand Electricity Supply Corporation, Ltd., for power to supply energy in the Council's district. The Council also decided to arrange a joint conference on the subject with the Woodford and Ilford Councils.

Colne.—The T.C. has applied to the L.G.B. for a loan of £5,020 for the purpose of purchasing plant, &c., for the supply of energy to the Colne and Trawden Light Railway Co.

Continental Notes.—Germany.—An electric lighting works is to be erected at Crenzburg.

Italy.—A committee has been formed in Catania to prepare a scheme for a projected co-operative central electric lighting station in the town.

Paris.—On January 5th the electric lighting of the districts of Faubourg-Montmartre, Vivienne, and Maubeuge, supplied by the Edison Co., broke down; this is stated to be the first breakdown of its kind in Paris.

Eccles.—The T.C. has resolved to make application to the L.G.B. for power to borrow £500 for the purchase of electric motors to let out on hire.

Gateshead.—The Town Improvement Committee reported that a notice had been received from the Electric Power Distribution Co., Ltd., of a proposal to lay mains from the power station in South Shore Road. The latter road is only 13 ft. wide in portions, and up to the present the company has laid 20 cables, each in a separate trench. Having regard to the fact that accommodation had also to be found in the road for the gas and water mains, and the public sewer, the Council refused to sanction the company's proposal.

Holyhead.—The L.G.B. has sanctioned the borrowing of £1,000 for the purpose of extending the electric lighting scheme into the outskirts of the town.

India.—Jamalpur.—*Indian Engineering* of December 10th last states that the East Indian Railway Co. are about to expend rather over one lakh of rupees for the supply of electricity to the houses occupied by the company's servants.

Madras.—The Government Press is now electrically equipped throughout. The installation comprises water-tube boilers, steam-driven direct coupled generating sets, and motors of various sizes. In view of the concession which Messrs. Crompton & Co., of Chelmsford, have secured for the supply of energy for lighting and power purposes in Madras, it seems exceedingly probable that the generating plant will be very speedily superseded.

Darjeeling.—The annual municipal report for 1903-4 shows that the experience of the municipality in its electric lighting has not been a happy one. The installation, which cost Rs.1,60,000 (or rather over £10,600) five or six years ago, has been worked at a loss throughout, while during the last financial year, another loan of Rs.60,000 had to be raised in order to prevent the head works at Sidrapong slipping down the hillside.

Johannesburg.—The report of the working of the Rand Central Electric Works for December, show that 798,000 units were generated, yielding a gross revenue of £7,400. For the corresponding period of the previous year, 693,185 units were generated, yielding a gross revenue of £6,344.

London.—Marylebone.—The B.C. has received a letter from the L.C.C. with reference to the proposed loan of £100,000. The County Council stated that it had cancelled its order of July 26th, 1904, and had re-sanctioned the borrowing by the B.C. of a sum of £433,800, repayable on conditions stated, and would issue such sanction on receipt of an agreement by the B.C. to provide for all renewals and replacements of any of the plant, machinery, and works provided with the proceeds of the sum of £340,405 before-mentioned, during its currency, out of a sinking fund established for that purpose, or from maintenance account. Subject to this the County Council is prepared to advance to the B.C. a sum of £100,000 (on account of the £340,405) upon the terms to be repaid with interest at the rate of £3 15s. per cent. per annum, calculated quarterly. The terms were accepted.

Hampstead.—According to the *Times*, the B.C. has concluded negotiations with the North-West Electricity Supply Co., formerly the Hampstead Electric Supply Co., to purchase its undertaking. Several years ago the late Vestry secured an order enabling it to establish a municipal electric supply, and the Council now has 5,000 customers. The Council's generating station is situated near the Midland Railway in Finchley Road, in the centre of the borough. The capital expenditure amounts to £346,508, and last year the income was £58,051. In spite of the fact that the private company was not allowed to lay mains in the public roads it succeeded in obtaining concessions to pass through private property, chiefly railway land, and so secured over 700 customers in the heart of the district. Its inability to extend the supply was a serious obstacle, and, after protracted negotiations, it was agreed to sell the whole concern to the Council for £12,000.

The B.C. is convening a conference of municipal authorities owning electrical undertakings to consider what action should be taken with regard to the Metropolitan Electric Supply Bill.

Battersea.—The Committee has agreed to accept penalties amounting to £90 from Messrs. C. A. Parsons & Co., in respect of nine weeks' delay in the completion of the contract for the turbo-generator set recently ordered from them. The consumers in the

areas transferred to the Council under the London Electric Lighting Areas Act, 1904, have now been connected to and supplied from the mains.

HACKNEY.—The B.C. E L. Committee reports that the nine ½-ampere inverted-type Nernst lamps experimentally fixed some time ago in Kenninghall Road having given satisfaction, it is intended to leave them permanently. The charge made for these is £4 per annum, including maintenance. cleaning, and lighting during the same hours as the gas lamps. The total cost of the nine electric lamps per annum will thus be £36—the cost, at the present price of gas, of the 11 gas lamps dispensed with being £33 8s. 1d.

CHELSEA.—It has been definitely decided by the B.C. to install an electric generating plant at the proposed new baths.

Manchester.—The chairman of the Electricity Committee stated recently that terms had been arranged in the matter of the action of Harters *v.* The Corporation, which was brought to recover compensation for vibration caused in the plaintiff's works by the Bloom Street generating station. The writ was issued two years ago. It was thought the Committee might have been able to avoid having to purchase any property, and an eminent authority on vibration was consulted. He proposed a scheme, which was tried, at a cost of several thousands of pounds, but it proved a failure. The City Council has now sanctioned the purchase of the two warehouses.

Middlesbrough.—The T.C. has resolved to lay another main to the yard of Messrs. Sir Raylton Dixon & Co., Ltd., at a cost of £340, complaint having been made of a serious drop in voltage over the existing main, and the consequent stoppage of work owing to the unreliable supply.

New York City.—A commission of three experts has been appointed to prepare general plans and specifications for a municipal plant along the lines reported in the ELECTRICAL REVIEW of December 16th last. The official investigation of the cost of existing lighting has been frustrated by the refusal of the New York Edison Co., to permit "an inquisitorial examination of its accounts." Various organisations have endorsed the demand for a municipal plant, but it is evident, says a New York correspondent, that the whole movement is being engineered for political purposes in view of the civic election of November next.

New Zealand.—TE AROHA.—The B.C. has favourably considered the question of a municipal electric light scheme, and resolved to call a poll of the ratepayers for authority to borrow the necessary capital. The proposed prices to consumers are the same as those obtaining at Gore; installation, 20s. each light, and lights per month, 1s. 9d. 5-C.P., 2s. 8-C.P., 3s. 16-C.P., 4s. 9d. 25-C.P. and 6s. for 32-C.P.

The Council has received offers from the Bank of New Zealand in regard to moneys for the electric light scheme, and has accepted from it a letter of credit up to £2,000, to draw upon for machinery to be purchased by Mr. Steuart in England. Tenders for loans are required.

NEW PLYMOUTH.—The Council recently considered the following tenders for the electric lighting of the town, which is to be on the single-phase alternating current system. It was resolved to accept that of the Brush Co., subject to details, &c., and to a license being obtained from the Government:—

The Brush Electrical Engineering Co. (Sydney)	£5,203 11
Turnbull & Jones (Wellington)	5,266 18
A. and T. Burt (Dunedin)	6,409 11
Steuart & Fenn (Auckland)	6,991 1
New Zealand Electrical Construction Co. (Christchurch) ..	7,586 0
Palmer & Co. (Wellington)	8,457 2

The above prices are for the supply and erection of the plant in working order and the maintenance of same for three months after. The tenders include all plant, &c., but not the power house and distributing station, the tail race, &c., and the transformers for private lighting. About 120 H.P. is available.

WATER POWER.—In regard to the large amount of water power available in the colony for industrial development, much further information has been collected since Mr. Hancock's departure, and a more detailed report on the subject prepared by Mr. P. S. Hay, the superintending engineertof the Pub. Wks. Dept. It is estimated that 3,700,000 H.P. is available, the bulk being in South Island. We hope to publish more detailed information in regard to this interesting projected water-power development in New Zealand.

Northfleet.—The negotiations between the U.D.C. and Gravesend T.C. for the transfer of the Northfleet E.L. order have been broken off, and the U.D.C. has now decided to oppose the application of Gravesend to the B. of T. for a prov. order extending its area of supply to Northfleet.

Penmaenmawr.—The U.D.C. has agreed that in the draft electric lighting order for the district, a clause should be inserted requiring an annual publication of accounts, a revision of the scale of charges every three years, and that the charge for electricity for public lighting should not exceed that made to ordinary consumers for the like purpose for the same hours of supply.

Rhymney.—The offer of the Tredegar Iron Co. to light the village of Abertysswg with electric light for £3 6s. per lamp per annum has been accepted.

Shanklin.—The U.D.C. has renewed the contract for public lighting with the local electric lighting company, to December 31st, 1907.

South America.—The Navy Department is drawing up plans for the erection of a large power house at Rio Santiago, La Plata, the estimated cost of the scheme being $100,000 gold.

Shrewsbury.—The T.C. has adopted a report of the Electric Lighting Committee, in which an enlargement of the station buildings, the provision of a Lancashire boiler, engine and dynamo, and accessories, at an estimated cost of £5,295, also the provision of a condenser room and storage tanks, at an estimated cost of £508 is recommended.

Stretford.—The generating station at Longford Bridge has recently been extended, and plant is now being erected sufficient to double the supply. A supply of energy will be required shortly to work the tramway extension to Urmston and the new Warwick Road and Seymour Grove route at Old Trafford. Further additions to the works are contemplated, as the Council are empowered to supply energy outside the boundary and also in the Trafford Park area.

Swindon.—The T.C. has applied to the L.G.B. for a loan of £,2000 for the purchase of motors and arc lamps for letting out on hire.

Tunbridge Wells.—A large consumer has asked the T.C. if it is prepared to enter into an agreement to periodically repair and test his installation and supply new lamps. The Council has replied that it has no power to do this.

The question of reducing the charges for energy is to be considered by the Lighting Committee.

West Ham.—On Tuesday the Corporation decided to build two underground transformer chambers, one in Selbert Road, Forest Gate, and the other at Custom House, at an estimated cost of £239 each with electrical equipment.

Westhoughton.—The U.D.C. has sealed an agreement with the Lancashire Electric Power Co. for a supply of energy for lighting and power. The suggested charges are 4d. per unit for lighting, and 2½d. per unit for motors of small power. The Council has been advised to take energy in bulk and distribute it.

Wilmslow.—Tests have been carried out between gas and electricity for street lighting, the latter proving very satisfactory. Terms having been arranged with the Alderley and Wilmslow Electric Supply, Ltd., the Council has decided on the substitution for the present system of street lighting by gas, of one by electricity, and is to erect the following lamps:—

170 lamps of 40 C.P., at 28s.	£238 0 0
39 lamps of 70 C.P., at 38s.	74 2 0
1 lamp of 140 C.P., at 123s.	6 3 0
1 lamp of 70 C.P., to burn one hour after sunset to daylight, at 70s.	3 10 0
	£321 15 0

The prices paid for gas have been:—

209 gas lamps, at 32s. 6d.	£339 12 6
2 ,, ,, at 110s.	11 0 0
1 lamp in Moor Lane, extra gas	0 15 6
	£351 8 0

Thus showing a saving over gas of £29 13s.

The lamps the company proposes to install are ¼ and ½-ampere Nernst. The ¼ ampere will be installed in place of the ordinary flat flame gas burner, and the ½ ampere replaces the incandescent mantle, and it is hoped shortly to commence laying the mains for street lighting and private supply throughout Wilmslow. The total length of these will be about 12 miles, and about three miles of feeders.

Wimbledon.—The Electric Lighting Committee has recommended that the electrical plant at the generating station should be extended by the addition of three 1,000-KW. turbo-alternators with condensers—the foundations and one set to be proceeded with. The matter is still under consideration.

Wootton (I.W.).—The manager of the Isle of Wight Electric Lt. & Power Co., in answer to inquiries, has given a rough estimate for the mains, &c., required to supply the above locality with electricity.

TRAMWAY AND RAILWAY NOTES.

Boston, Mass.—The tramway tunnel under Boston Harbour was opened for passenger traffic on December 30th. The tunnel is 5,800 ft. long, of which 2,700 ft. is under water. The time taken in transit by trolley cars is 3 min., and the fare 1 cent. The tunnel has been leased to the Boston Tunnel Co. until 1922, on a basis of a rental of ⅜ths per cent. on gross earnings.

Buenos Ayres.—A River Plate exchange says that the Government has instructed the Solicitor-General to take the necessary measures to obtain the payment of the fine of $30,000 m/n incurred by La Capital Tramway Co. for non-fulfilment of contract regarding the extension to Jan Justo.

Canada.—According to *Industrial Canada*, plans have been completed for the $200,000 power house of the South-Western Traction Co., which will be erected either at Lambeth or near St. Thomas. The station will furnish power for the operation of 30 miles of electric railway in the neighbourhood of London.

Crewe.—By 12 votes to 4 the T.C. has declined to support an application by a local syndicate for power to construct and work electric tramways in the town.

Aberdare.—The U.D.C. has, by 11 votes to 4, approved of the electric tramway scheme, the estimated cost of which, including the construction of new streets and street widening, is £93,576.

Colombo.—*Indian Engineering* says that the tramway track is to be relaid early this year with a 95 lb. rail as against a 67 lb., the weight of the present rail. There will be a specially heavy section for use on curves only, weighing 101 lb. per yard. It has been suggested that the rails shall be welded by the Thermit process.

Dewsbury.—Our local correspondent says:—"At the meeting of the Batley T.C. on Thursday, January 5th, reference was made to the delay in the electrification of the steam tramways from Dewsbury to Gomersal, *vid* Batley. The Mayor said everything had been done by the Corporation to facilitate the work. Its engineers had everything prepared for the work being done. The delay, therefore, rested with the B.E.T. Co. The tramways belong to the company, and a promise was made when they took them over two or three years ago that the work of electrifying the system would be put in hand without delay. There is much grumbling throughout the district that the work is not being proceeded with."

At the meeting of the T.C. last week, the town clerk reported on the appeal of the British Electric Traction Co. against the decision of the Dewsbury magistrates, who imposed a small fine for running cars without a licence. The appeal was upheld. In answer to a question, the town clerk said he could not state what the expenditure would be. One member (Col. Wilby) suggested that the town clerk ought to have been in a position to tell the Council that it had no case. The ratepayers' money had been wasted, and the Council made the laughing stock of the community. On the other hand, Councillor McCann stated that the town clerk simply acted on the instructions of the Watch Committee. It was not that the Corporation desired to obtain the 5s. per annum or whatever the amount might be. What it desired was to have control of traffic on the roads. There were tramways on almost parallel roads, and in one case every tram had to be licensed, whilst in the other, cars running up and down a steep gradient were not licensed. A state of things like that did not reflect credit upon the authorities who granted the tramways. The Mayor also suggested that if anyone was to blame it was the magistrates, and not the town clerk. Better men than the town clerk had had appeals made against their cases. The best judges in the land had had their decisions reversed in the Appeal Courts.

Dartford.—The U.D.C. has applied to the B. of T. for an extension of time to November 13th, 1906, in which to commence the works scheduled under the Light Railway Order, 1902.

Glasgow.—The Corporation tramways department reports that total receipts up to January 7th were £457,766, compared with £435,308 for the corresponding period of last year. For the week ending January 7th, the receipts were £17,069, and for the corresponding week of last year, £14,619.

London.—It is announced that the Board of Trade, after full consideration of all sides of the question which has long been in dispute, has approved the use of a slot not exceeding 1 in. in width, in connection with the underground conduit system for the electrification of the London County Council tramways in North London.

Melbourne Railways.—The *Australian Mining Standard* says that, with a view to extending the travelling facilities in the suburbs of Melbourne, the Premier, the Hon. T. Bent, has announced that he intends to refer a number of proposed electric lines to the Railways Standing Committee for consideration during the recess of Parliament. The proposed lines are as follow:—

1. From St. Kilda Station to the Village Belle, to connect with the line already authorised by Parliament from the latter point towards Brighton.
2. From Graham Street, Port Melbourne, to St. Kilda.
3. From Prahran (Brighton line), passing the Malvern Town Hall, to Glen Iris.
4. From High Street, Kew, along Glenferrie Road to the Malvern station.
5. From Flinders Street to Fitzroy.
6. From Sandringham to Cheltenham.
7. From Beaumaris to Mordialloc.
8. From Caulfield to Balaclava.
9. From Elsternwick to Glen Huntly.

Mr. Bent states that if the construction of the Essendon line were not undertaken by the authority (Mr. A. E. Morgans, M.L.A., of of Western Australia), to whom the local councils proposed to delegate their powers, he would be inclined to refer that project also to the Committee, with a view of making it a Government line. The report of the Committee will be first of a general character, and subsequently it will deal in detail with any lines which Parliament may specifically refer to.

Newcastle-on-Tyne.—At a meeting of the T.C. on the 4th inst., it was reported that at the end of the financial half-year there was a profit, after paying interest, &c., of £3,500. They had, said the mayor (Alderman Ellis), cut down the expenses by £300 a week. In answer to Mr. Hutchinson, he stated there was an engineering difficulty in working the tramways up Fisher Hill, Walker, there being a curve with an incline of 1 in 8. A new bridge had been built at a cost of £2,324, but that had not helped them out of the difficulty.

New York Elevated Railway.—The New York correspondent of the *Morning Post* says that on the morning of January 6th a collision occurred at Ninth Avenue on the Elevated Railway. A burnt out electric fuse on a down-town train caused the train to come to a sudden stop at Horatio Street. Another train stopped a few feet behind the stalled one, but a third train was not signalled in time and crashed into the second one, telescoping the rear cars. An electrician who was examining the second train was killed and 11 persons were injured.

New York Subways.—The subway, as far as opened, carries about 300,000 passengers daily after two months' operation. In spite of this apparent diversion of traffic, there is as little standing room as ever on the older surface and elevated lines. Mr. Wm. B. Parsons, on the eve of his retirement as chief engineer of the Rapid Transit Commission, presented detailed plans for several new subways. The lines have been laid out so as to allow of competition for the operating privileges.

New Zealand.—WELLINGTON.—A few weeks ago fines of £160 each were imposed on the company under contract with the City Council for the supply and erection of the electric tramway power station, and on Mr. Newton N. White, the company's representative, for carrying on operations in the country without a license. The question at issue was whether the company in carrying out these contracts entered into in England was "carrying on business" in New Zealand. The defence submitted was that the company carried on its business in England, and that in completing a portion of it in the Colony it did not transfer its business there. The magistrate held otherwise, but intimated that if one of the defendants paid the fine and costs, he would recommend the remission of the other. Notice of appeal was given.

CHRISTCHURCH.—A dispute arose recently between the Christchurch General Labourers' Union and the company constructing the electric tramway in the city as to the proper wages for pick and shovel work. A case was heard against the company for paying labourers for this work 7s. instead of 8s. per day, contrary to the award of the Arbitration Court. Local contractors stated that they paid men 1s. an hour, and the city surveyor stated that the Council paid at the rate of 7s. per day, and the railway engineer for Canterbury also stated that for the surface work done by the company's men 7s. a day would be paid by the railway department, and that would be under the scale provided in the Government Railways Classification Act, which was expressly exempted from the operation of the award. The Public Prosecutor, who appeared for the prosecution, argued that the standard of wages must be sought in the award of the Arbitration Court and in the industrial awards filed. The magistrate said, in dismissing the case, that the Court was not competent to settle the question.

AUCKLAND.—Mr. P. M. Hansen, managing director of the Auckland Electric Tramways, has recently returned from a tour in Europe and America, where he studied the various tramway systems in operation. He states that negotiations for further extensions of the company's system are to be entered into. New cars have recently been delivered from England, and the company is building locally another of the Californian type; several combination cars are ordered, and these will carry 10 more passengers, and the horse-power of the motors will be 52 instead of 40 as on those at present in use.

Niagara Falls.—A new endeavour is to be made by the Lockport and Ontario Power Co. to obtain larger water rights. Last year's measure was vetoed by the Governor of the New York State, but, with a new Governor coming into office on January 1st, and some modification of the enormous demands of the promoters, the application has a chance of success. Existing interests at Niagara Falls are strongly opposed to the scheme, which, if carried out on its original lines, would give an unlimited monopoly in perpetuity for the supply of power to any part of New York State.

South Shields.—At the meeting of the T.C. on the 4th inst., the Tramways Committee recommended that the Council, with the sanction of the L.G.B., should appropriate the site in Dean Lane for the erection of car-sheds, and that application be made to the L.G.B. for permission to construct a service line in Dean Lane for the purpose of providing access to the sheds. Councillor Grant said that the site in Dean Lane was more suitable than that occupied by the present car-sheds, and the cost of utilising the new site would be only £12,000 more. Another advantage was that there was greater space for extensions. It was resolved to advertise for tenders for the construction of the tramways.

West Ham.—The tramways manager submitted to the Corporation at its meeting on Tuesday, a statement showing as follows the average fare charged per mile on the systems which have adopted ½d. fares:—Aberdeen, ·82d.; Halifax, ·79d.; Kirkcaldy, ·78d.; Ilford, ·75d.; Dundee, ·69d.; Ayr, ·68d.; Birkenhead, ·67d.; Leeds, ·66d.; Rotherham, ·64d.; London County Council, ·62d.; East Ham, ·62d.; West Ham, ·56d.; Sheffield, ·50d.; Glasgow, ·45d. In the first seven months' running of the cars in West Ham, the ½d. passenger took 41 per cent. of the utilised accommodation, while he paid less than 24 per cent. of the receipts. Having regard to the local conditions, he did not estimate the normal average expenditure (including capital charges) per car-mile as likely to be less than 9·5d., and he should not be surprised if this figure were exceeded. Under these circumstances, and in view of the peculiarities of the traffic in West Ham, he was convinced that the carrying out of the reduction of fares advocated by some councillors would be fraught with great danger to the undertaking. In conclusion, the manager put forward suggestions for the revision of eight ½d. and two 1d. stages, which, in his opinion, would afford additional facilities to the public without unduly crippling the undertaking. The report was adopted.

West Hartlepool.—At the meeting of the T.C. on the 3rd inst. the Works Committee reported that a letter had been received from the Tramways Co., submitting a proposal for the settlement of the complaints with reference to the condition of the track, to the effect that the Corporation should waive the right of purchase of the several lines in the borough until 1919, the Tramway Co. at the same time to agree to a reduction of tenure of the Seaton Carew line to that date. The company would then reconstruct the permanent way and the overhead equipment in the early spring. The Committee came to the conclusion that the proposals submitted were not such as they could recommend for acceptance, and as they were of opinion that further negotiations were not likely to be brought to a successful issue, the company must carry out the several obligations imposed upon it by the Acts and Orders affecting the company's operations. The Committee also resolved that notice be served on the company requiring it to sand the track where dangerous through slipperiness. The borough engineer reported that since December 12th the Tramway Co. had not done anything in the way of repairs to the track in Clarence Road and Cleveland Road, and reported that nothing short of reconstruction would be considered a remedial measure. Alderman Suggitt moved the adoption of the report, and said that the tramways were still in a very unsatisfactory state, despite the penalties recently inflicted. The report was adopted.

TELEGRAPH AND TELEPHONE NOTES.

Buenos Ayres Telephone Wires.—The Public Lighting Department has sent in a long report to the Mayor in connection with the telephone wires. These are said to be in a very bad condition, have been installed without system, and are a source of constant danger. All the electric tramway companies have had to pay for the cost of lifting these wires. The department is of opinion that the telephone companies should be made to put their lines up properly, and also to comply with the decree of November 16th, 1900.—*Review of the River Plate.*

Cable Communication with West Indies.—Reuter's correspondent at Barbados, writing on November 23rd, says:—"In view of the reecnt discussion which has taken place on the matter of the cable services in the West Indies, and the visit of the President of the West India and Panama Telegraph Co. to Barbados, it may be of interest to the general public to know that the Halifax and Bermuda and Direct West India Cable Companies have made an offer to the Imperial Government to improve the cable communication of the West Indies (1) by a direct cable from Bermuda to Barbados, and thence to Trinidad, Demerara, and St. Lucia, and from the latter place to Jamaica, thus connecting the principal West Indian Colonies by a British cable; (2) by reducing the rates to these places and all they connect with. This service would thus practically become a direct service from Barbados to Halifax, thence to Canada, Europe, and the United States, and would be of inestimable value for Imperial purposes should such need ever arise."

Hull Telephones.—"Ratepayer," in a letter to the local Press, refers to the arrangement under which a number of subscribers to the Corporation system are being supplied with a service free of charge. The arrangement between the Corporation and the subscribers is, that no charge shall be made for the service until such time as the subscriber's contract with the National Telephone Co. can be determined. "Ratepayer" says he knows of a number of such cases where the period of free service varies from 4 to 10 months. He points out that a telephone service cannot be supplied without considerable cost, and any system run on these lines cannot be self-supporting, with the result that the loss must fall upon the rates.

Submarine Cable to Panama Canal.—At Washington, on December 8th, a Bill providing for the connection of the canal zone on the Isthmus of Panama with the United States by cable was introduced by Representative Wagner, of Pennsylvania. The Bill provides for the construction and operation of such a cable under the control and direction of the Postmaster-General, the Secretary of War and the Secretary of the Navy, the cable to be of American make and to be laid by American ships, provided the cost of an American-made cable will not exceed the cost of a foreign-made cable by more than 10 per cent. The total cost of the cable is fixed at $2,000,000, and $300,000 is made immediately available for its construction. The three Cabinet officers are authorised to enter into negotiations and establish cable connection with lines running to Central and South America, the West Indies and islands in the Gulf of Mexico, the Caribbean Sea and the Pacific Ocean.—N. Y. *Electrical World and Engineer.*

The Telegraph Export Trade.—The past year has been one of the quietest on record as regards the export trade of this country in telegraph cables and apparatus connected therewith. The aggregate shipments during the 12 months only reached a total of £865,338, as contrasted with £1,808,465 in the preceding year, and no less than £2,838,641 in 1902.

The Telephone Situation in Paris.—The Association of Telephone Subscribers, who have been drawing attention to the unsatisfactory condition of telephone affairs, have obtained a report from Mr. H. Laws Webb, in which he points out that the underlying causes of the present bad service and relatively small development are that Paris has retained in use apparatus and methods of working which have been superseded in countries where the science of telephony is in an advanced state. Taking the system as a whole, the technical equipment and the general method of working are those of the earliest days of exchange telephony. In a large system, composed of many exchanges connected by junction lines, the work is complicated and voluminous, and the result of the use of antiquated apparatus is necessarily the production of two evils—first, the irregular working of the apparatus itself; and, secondly, the demoralisation of the operators through having to work with apparatus which causes so many errors and confusions. The exceptional position of Paris in that the subscribers furnish their own instruments leads to direct and indirect unsatisfactory results, of which not the least is the continued and extensive use of primary batteries for signalling the exchanges. It is hopeless to expect any great or general improvement in the *personnel* without a general improvement in the apparatus and methods, because such defective material and methods react upon the nerves, manners, and general demeanour of the operators as well as of the subscribers. The adoption of modern apparatus and the introduction of the message rate system, scientifically planned, would result in a considerable increase in the number of subscribers.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	Dec. 18, 1904	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 23, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Paramaribo-Cayenne	July 18, 1904	
Sitka-Valdes	Nov. 11, 1904	
Cape Haiti-Puerto Plata	Dec. 25, 1904	
Bathurst-Sierra Leone	Dec. 27, 1904	Dec. 30
Assab-Perim	Dec. 26, 1904	
St. Vincent-S. Thiago	Dec. 27, 1904	Jan. 4
Gibraltar-Tangier	Dec. 23, 1904	Jan. 3
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto-Barrios	July 28, 1902	
Kerich-Soutchoum	Sept. 27, 1904	
Rome-Pera	Jan. 3, 1905	Jan. 10
Elarich-Hanekin	Jan. 7, 1905	Jan. 8

Telephones in London.—Great progress continues to characterise the Post Office telephone service in the Metropolitan area, says the *Standard*. It is not three years ago that the Central Exchange was opened, and since then 10 others have been established; at the end of 1903 there were no fewer than 14,301 telephones at work in the Western, Victoria, Mayfair, Hampstead, Putney, Wimbledon, Richmond, Kingston-on-Thames, Chiswick and Croydon areas, but the total has since been increased to 22,181. In a few months exchanges will be opened at Epsom and Ealing, and others are contemplated at Crouch End, Finchley, Harrow, Willesden Green, Wembley, The Hyde (Hendon), Barnet and Kenley. The switchboard at the Central Exchange, Queen Victoria Street, was first constructed to carry lines for about 6,000 subscribers, but has now been enlarged to its full capacity, viz., 15,000. It has been decided to erect in the same building a new exchange with a capacity of 18,500 lines.

Western Union Telegraphs.—The *Journal of the Telegraph* states that the surplus of the Western Union Co., on July 1st, 1904, was $14,881,428 (£2,976,285), and the net revenue for the quarter ended September 30th last $2,088,004 (£413,600). After providing for interest and dividend on bonded debt, there remains a surplus on October 1st of $15,434,862 (£3,086,972). At December 31st, allowing $2,000,000 (£400,000) for receipts, and the proper amounts for dividend and interest, the surplus was estimated at $15,920,292 (£3,184,058).

Wireless Telegraphy.—An *Express* telegram from Rome states that Signor Marconi has informed the *Tribuna* that he can now transmit 30 words a minute. His company, he states, will "shortly" pay a dividend.

Signalling at sea between ships of the Royal Navy and of the merchant service is now under consideration by a committee, which will deal with the matter in all its bearings in its report.

The Postmaster-General has authorised the use of abbreviated or registered telegraphic addresses of firms or individuals in sending wireless telegrams (Marconigrams) to or from ships at sea, subject to the regulations governing the use of such addresses in inland telegrams.

It is reported by Reuter's agent at Rome that an agreement has been signed between the Italian Government and the Marconi Co. for the construction of a powerful station at Coltano, intended to communicate with stations in Great Britain, Erythrea, the Netherlands, and other countries.

On January 5th, Reuter's Rome representative said that Mr. Marconi had gone there in order to sign a new convention with the Italian Government providing that the wireless telegraph station at Boltano, which was to have maintained communication with Argentina, should, in the absence of a similar station in Argentina, be utilised for communication with Great Britain, Holland, Canada, and other countries. He was also to open negotiations with the Italian Government for establishing regular communication between the stations of Bari and Poldhu.

The special correspondent of the *Standard* states that communication between Port Arthur and the outside world was destroyed on October 6th last.

According to the same authority, the Russian authorities in Paris decline to admit that any specific wireless telegraphic message exchanged between vessels of the Baltic Fleet was captured. They state, however, that their messages were persistently intercepted, by whom they do not profess to know, but they believe that a Japanese agent was at work off the Danish coast. It is admitted that the British Fleet may possibly have received and deciphered a wireless message from one of the Russian vessels when they were in the Channel after the outrage.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—January 17th. Overhead equipment for tramways. See "Official Notices" December 30th.

Australia.—February 7th. Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, for (1) 3,500 trunk line multiple jacks, in strips of 20; (2) 1,320 yards of 64 wire wool insulated switchboard cable. Specifications at the General Post Offices at Melbourne, Sydney, Brisbane, and Adelaide.

Belgium.—February 13th. Tenders are being invited until February 13th by the Municipal Authorities of Ghent for the supply of 15 electric cranes for use in connection with the docks. Tenders are to be sent to l'Hotel de Ville, Ghent, whence particulars may be obtained.

Bradford.—January 16th. The Guardians invite tenders from electrical engineers for certain work at two hospitals at the Union Workhouse, Horton Lane, Bradford. George M. Crowther, Clerk to the Guardians, Union Offices, 22, Manor Row, Bradford.

Drax.—January 28th. Schemes for electric lighting and electric pumping at Read's Grammar School, Drax, near Selby, are invited. Apply Head Master, Mr. W. St. G. Drennan, at the School.

Gravesend.—January 16th. The Education Committee invite tenders for the electric lighting of King Street National School. Specification, &c., on application to Mr. C. F. McInnes, Electricity Work.

Halifax.—January 31st. Coal conveyor, shutes, &c., for the electric light and tramway power works. See "Official Notices" January 6th.

Handsworth.—February 2nd.—The U.D.C. is inviting tenders for power and lighting circuits and fittings in the generating station; pipework, feed-pumps, economiser, electricity meters. See "Official Notices" to-day.

Holland.—January 18th.—The Dutch Post and Telegraph authorities at the Hague are inviting tenders until the 18th inst. for erection of eight additional wires in connection with the telephone line between Halfweg and Hoofddorp, and twelve more wires between Hoofddorp and Oudsboorn.

Johannesburg.—January 26th. Vignoles rails, fishplates, rails, bolts, nuts, &c. See "Official Notices" December 23rd.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

London.—January 16th. Tenders for a 750-KW. steam alternator with pipe connections, &c., for the South London Electric Supply Corporation, Ltd. See "Official Notices" December 23rd.

London.—January 24th. Fire alarm installation for the Northern Hospital, Winchmore Hill, N., for the Metropolitan Asylums Board. See "Official Notices" December 30th.

Port Elizabeth.—January 16th. Water-tube boilers, 400-KW. turbo-dynamos, mains, battery and boosters, switchboard, crane, public lighting, meters, workshop equipments and other plant, &c., for the Electricity Supply Undertaking. See "Official Notices" December 16th.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession of the exclusive right of the working of the tramways for collective transports of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Pudsey.—January 20th. Underground mains, junction boxes, switchboard, &c., for the Corporation. See "Official Notices" December 16th.

Roumania.—January 28th. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

South Shields.—February 20th. Permanent way and construction of track; rail bonds and bonding; conduits, cables, and overhead equipment for the Corporation. See "Official Notices" to-day.

Swindon.—January 24th. One 30 ft. × 8 ft. Lancashire boiler, with superheater, piping, &c. See "Official Notices" December 30th.

Warrington.—January 16th. Earthenware ducts for one year. See "Official Notices" to-day.

Whitechapel.—January 16th. The electric lighting of Section 2 of the Infirmary, for the Guardians. See "Official Notices" December 30th.

CLOSED.

Bedford.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of 300 A.C. meters, the company to take 250 Chamberlain & Hookham meters, at 5s. each.

Birmingham.—The Brush Electrical Engineering Co., Ltd., has secured the contract for 32 traction motors for the Birmingham and Midland Tramways.

Canterbury.—The T.C. has accepted the following tenders for plant at the Electricity Works:—

Davey, Paxman & Co., boiler and superheater.
Dick, Kerr & Co., Ltd., 300-KW. steam dynamo.
J. G. Statter & Co., switchboard.
E. Green & Sons, Ltd., additions to economiser.

Derby.—The T.C. has given the contract for the extension of the electric tramways from St. Peter's Street to the Market Place, to Messrs. White & Co., of London, at £3,000.

Devonport Dockyard.—Messrs. Graham, Morton & Co., Ltd., have just obtained the contract for the supply, delivery and erection, at the Electrical Generating Station at H.M. Dockyard, Devonport, of a complete coal-handling plant, including coal bunkers, stanchions, girders, flue, coal measuring and weighing apparatus and all accessories appertaining to same.

Dewsbury.—The tender of Messrs. Measures Bros., of London, for the supply and fixing of steel floor plates for the boiler house at the electricity works has been accepted by the Corporation; also that of Messrs. Siemens Bros. & Co. for two large station watt-meters, and that of Messrs. Bennis & Co. for the supply of an automatic stoker for the new boiler.

Dockyard Installations.—The Lancashire Dynamo and Motor Co., Ltd., of Trafford Park, have just received from the Admiralty the order for the equipment of Bull Point Dockyard. They have also at the present time in hand contracts for the equipment of Sheerness and Malta Dockyards, the total value of these contracts being upwards of £75,000.

France.—The French Post and Telegraph Authorities in Paris have just given out contracts as follows:—M. Grammont, Pont de Cheruy (Isere), 80 kilometres of telephone cable with seven pairs of conductors and 15 kilometres of telegraph cable with 42 conductors; La Société Alsacienne de Constructions, Mecaniques, Belfort, 30 kilometres of telephone cable with 28 pairs of conductors; and La Société Industrielle des Telephones, Paris, 20 kilometres of telegraph cable, with three pairs of conductors.

Leyton.—The U.D.C. has received the following tenders for the supply of six miles of cable for public lighting:—

Western Electric Co., Ltd. (accepted)	£546 0
Johnson & Phillips	540 0
Dennis & Co.	543 9

Lincoln.—The T.C. has accepted the tender of the Chloride Electrical Storage Co., Ltd., for the maintenance of the storage batteries at the electricity works for five years.

Newport (Mon.).—The Corporation has accepted the following tenders:—

Dempster, Moore & Co., at £225, for machine tools.
G. Hatch, at £125, for a wheel grinder.

Salford.—The T.C. has accepted the tender of the British Westinghouse Electric & Manufacturing Co., Ltd., for the supply of a booster in connection with the supply of current to the Manchester Ship Canal Co., at £478.

Whitby.—The U.D.C. has accepted the tender of Messrs. C. A. Parsons & Co. for a 200-KW. steam turbine, for £1,550; also that of Messrs. Johnson & Phillips for switchboard panel, at £92.

Swansea.—The Telephones Committee has decided to extend the switchboard accommodation, and the tender of the British Insulated & Helsby Cables, Ltd., at £270, has been accepted for the work, also their tender for cables, at £194.

West Ham.—The Corporation has accepted the following tenders in connection with the electric lighting undertaking:—

Resetting two boilers, Messrs. Windsor & Co., £278 10s.
Two panels on traction board, British Thomson-Houston Co., £180.
Supply and repair of coils, Messrs. Ferranti.
Reinstating chain grate stokers in three boilers, Messrs. Babcock & Wilcox, £180 per boiler.

FORTHCOMING EVENTS.

riday, January 13th.—At 8 p.m. Institution of Civil Engineers (Students). "Theory of Electricity and Magnetism," by Mr. James Swinburne.
At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). Mr. A. E. Jepson on "Electric Heating: Its History and Development."
Monday, January 16th.—At 3.30 p.m. (Oxford Circus Station). Tramways and Light Railways Association. Visit to the Central London Railway power station.
Tuesday, January 17th.—At 7.30 p.m. I.E.E. (Manchester). Mr. H. W. Wilson on "Electric Driving in Textile Factories."
Wednesday, January 18th.—At 8 p.m. Society of Arts. Captain L. James on "Wireless Telegraphy and War Correspondence."
At 7.30 p.m. Institution of Electrical Engineers (Students). Mr. A. L. Stanton on "Notes on the Construction and Maintenance of Large Telephone Exchanges."
I.E.E. (Birmingham). Meeting postponed to the 25th inst.
Thursday, January 19th.—At 8 p.m. Rugby Engineering Society. Mr. H. S. Meyer on "A Novel System of Electric Traction."
Friday, January 20th.—At 9 p.m. Royal Institution. Prof. Sir James Dewar on "New Low Temperature Phenomena."
At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Meeting.

THE ELECTRICAL VOLUNTEERS.

THE following orders are announced for next week:—

Monday, January 16.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Tuesday, January 17.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.
Wednesday, January 18.—Company drill under the Adjutant at Westminster Hall, 7.30 p.m.; doors open 7.15. Drill order; red tunics. Lecture by the Adjutant at headquarters 8.30 p.m., as per order No. 9 of January.
Thursday, January 19.—"C" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture by Captain Phillips on "Portable Field Engines and Searchlights."
Friday, January 20.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Saturday, January 21.—Week-end class.

WILFRID C. DUMBLE, Captain, R.E.,
For O.C.E.E.R.E. (V.)

NOTES.

Preparation of Peroxidised Accumulator Plates.—Dr. J. Diamant, of Raab, in Hungary, has taken out a German patent for a process of manufacturing lead plates of large size coated with peroxide for use in accumulators. The process is an electrolytic one, and depends on the addition to the electrolyte of such compounds as, under the influence of the electric current, yield anions which form more or less soluble compounds with lead. The more readily soluble these compounds are, and the more completely they are converted into peroxide and the respective anion, the more quickly is the peroxide film formed: but the properties of the latter also depend upon the physical conditions obtaining during the electrolysis, *e.g.*, the temperature of the liquid, the current density, and the presence or absence of indifferent ions. The substances specially mentioned for addition to the electrolyte are methane mono-sulphonic acid, disulphonic acid, and trisulphonic acid, as well as the hydroxyl derivatives of the two latter; or, in fact, such bodies as are produced by the action of sulphuric acid, fuming sulphuric acid, or sulphuric anhydride upon organic substances containing detachable methyl groups, *e.g.*, methyl alcohol, ethyl alcohol, acetaldehyde, acetic acid, &c. The substituted methane compounds may either be separated one from another by the aid of the differences in their solubilities, and added in the pure state to the electrolyte, or they may be employed as a whole. On electrolysis they yield only sulphuric acid and carbon dioxide, so that they can do no harm to the prepared plates.

Electrodes of Magnetic Iron Oxide.—The Chemische Fabrik Griesheim-Elektron, of Frankfort, has taken out a German patent for a process of manufacturing ferric oxide electrodes from burnt pyrites. Pyrites which have been burnt and freed from copper, are fused in an electric furnace, and the melt is cast into the desired shapes. The material is said to be much cheaper than the best magnetic ironstone, and to be particularly suitable for the preparation of electrodes on account of its purity. The foreign matter is almost entirely removed in the electric furnace, for the lead volatilises, the copper oxide is mostly destroyed, and the sulphur is burnt. The electrodes have 6·6 times the conductivity of those made from magnetic ironstone, and are claimed to be specially useful for the electrolysis of alkali chlorides. They are more economical than electrodes of carbon or platinum, yield a chlorine free from carbon dioxide, and require a considerably lower voltage than electrodes of platinum.

Electricity in Factories and Workshops.—The electrical engineer to the Halifax Corporation has submitted to the Town Council communications from the Home Office as to the use of electricity, together with draft regulations proposed to be made under Section 79 of the Factory and Workshops Act (1901). These have been submitted for consideration to the Electricity Committee.

Fire.—It is said that the fire which occurred at the Bucks County Asylum at Stone on Monday was caused by the fusion of an electric light wire.

The I.M.E.A.—A meeting of the Municipal Electrical Association is to be held in London on 14th inst.

London, Brighton and South Coast Railway and Electric Traction.—The directors of this railway have definitely decided to equip a section of their line, between Battersea Park and Peckham Rye, for electric traction on the single-phase overhead conductor high-tension system, similar to that which we described in the ELECTRICAL REVIEW of Dec. 16th and 23rd last. A shuttle service will be run between the points above-named, and the capabilities, &c., of the system thoroughly tested, preparatory to gradually extending electric traction throughout their suburban system. The conversion of the main lines to electric traction is not contemplated. Further particulars will be given in a later issue.

Appointments Vacant.—An assistant electrical engineer is required by the Bombay, Baroda and Central Indian Railway Co., on a five years' agreement, at Rs.400 per calendar month; "a gentlemanly young fellow" is wanted for Coventry electricity works.

The Royal Commission on Coal Supplies.—This Commission, which has been taking evidence for nearly three years, and has held 60 sittings, concluded the revision of its final report on Saturday. The document will be issued shortly.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Finance Committee of the Battersea Borough Council reported on Monday having adjourned to the 16th inst. the consideration of recommendations by the Lighting Committee. These recommendations were that Mr. J. H. FOOKS BALE having, in a letter dated December 24th, withdrawn from his appointment as chief electrical engineer, Mr. W. A. KEMM, chief assistant electrical engineer, be appointed at a commencing salary of £350 per annum, with residence; further, that applications be invited by advertisement for the post of chief assistant electrical engineer at a commencing salary of £175 per annum.

Mr. FOOKS BALE, of Birkenhead, has been appointed electrical engineer and tramways manager to the Walthamstow Urban Council at a salary of £400 per annum.

Mr. ROGERS, assistant engineer at Chester electricity works, having removed to another appointment, the Committee decided on the advice of the engineer to rearrange the duties of the assistant engineers by making Mr. DIMMACK mains superintendent, and appointing a station superintendent. By this arrangement there will always be an engineer in charge of the station. Out of 118 applicants Mr. PERCY HEARD, Westminster, was appointed station superintendent, at a salary of £130 per annum, rising to £180.

Mr. CHARLES DUDDING who was, until 15 months or so ago, chief assistant at the Hastings electricity works, is now joint station engineer to the Cape Town Corporation electricity works.

The following appointment has been made at the Bridlington Corporation electric works:—Assistant engineer, Mr. SIMPSON (Sheffield). There were 155 applicants.

The Malvern U.D.C. has appointed Mr. WM. G. PICKVANCE, of Farnworth, as foreman at the electricity works, at an annual salary of £130.

Mr. ARTHUR T. SMITH has resigned his position as chief assistant at the Bury electricity works in order to take up the duties of borough electrical engineer at Leigh, Lancashire. The Bury staff presented Mr. Smith with a dining-room clock.

Mr. E. E. JOHNSTON, of the Newcastle-on-Tyne Electric Supply Co., Ltd., has been appointed distributing assistant in the Belfast Corporation electricity department. He takes up his duties on January 16th.

The Bury T.C. has appointed Mr. S. E. PAYNE, of Tynemouth, as works superintendent at the electricity works, at a salary of £120 a year, rising by £10 annually to £150.

Mr. R. B. LEACH, chief assistant engineer, has been appointed chief electrical engineer and manager to the Farnworth Council.

Mr. CYRIL M. SHAW, of Wakefield, has been appointed electrical engineer at Worcester, at a salary of £400 per annum, rising by £20 a year to £500. The other candidates in the running were: Mr. W. J. Bache, Gloucester, and Mr. E. E. Hoadley, of Maidstone. Mr. Shaw received 29 votes, Mr. Hoadley seven, and Mr. Bache five.

Tramway Officials.—The employés of the Middleton Electric Traction Co. have presented a silver and cut-glass tantalus and a gold ring to Mr. M. RATHBONE, the retiring general manager. Mr. Rathbone, who is succeeded by Mr. W. F. ENDEAN, who was formerly connected with the Devonport and district tramways, has undertaken the management of the Ashton Tramways Co.

A *River Plate* exchange says that Mr. KUHUE has arrived out there from Germany to take charge of the conversion of the City of Buenos Ayres Tramway Co.'s system.

General.—The staff of the telephone department of the General Electric Co., Ltd., Peel Works, Salford, spent an enjoyable evening on Saturday, January 7th, at the Exchange Hotel, Manchester, at a smoking concert in honour of the general manager, Mr. A. BROOKER, on the occasion of his approaching marriage which takes place on the 14th inst. There was a crowded gathering, amongst the guests present being Mr. A. Eckstein, managing director of the company; Mr. W. Slingo, of the G.P.O. engineering department, Liverpool; Messrs. Bayley and Wilson, of the National Telephone Co., and many others. Mr. Brooker's health was proposed by Mr. A. Trafford, and was drunk with enthusiasm. Immediately afterwards Mr. G. C. Vyle performed some marvellous tricks with his wonderful Chinese box, culminating in a really startling experiment, in which the thoughts of the whole of the staff and workpeople were collected inside this box and transformed into a very handsome solid silver fruit and flower epergne, which Mr. Brooker was asked to accept. Later on considerable amusement was caused by the solemn investiture of Mr. Brooker by the chairman into the privileges of the "ancient and mystic order of the latchkey."

At a meeting of the directors of the Underground Electric Railways Co. of London, Ltd., on Tuesday, Lord GEORGE HAMILTON, M.P., and Mr. J. CLIFTON ROBINSON were elected directors of the company.

We are informed that Mr. P. W. SANKEY, for several years works manager of Messrs. Johnson & Phillips's electric cable works, has severed his connection with the firm. Mr. Sankey has been with the firm since 1894, and has held the position of works manager of the electric cables works for the past seven years.

On January 27th Sir WILLIAM PREECE will open the new electrical department of the Cardiff Infirmary.

Mr. PATRICK I. RICE, of the Brush Electrical Engineering Co., Ltd., is about to leave for Brazil, to take up the post of managing electrical engineer to the Companhia Edificatore, of Rio de Janeiro, to electrify an existing steam railway and carry out other important electrical undertakings.

It is reported in our Indian exchanges that Mr. J. W. MEARES, M.I.E.E., who has been electrical engineer to the Bengal Government since April, 1898, will fill the new appointment of electrical engineer to the Government of India, of which we gave some particulars a few weeks ago.

The Lancashire Electric Power Co., of Manchester, has decided to open a hire-purchase branch of its business in the Lancashire district, and has appointed Mr. PHILLIP C. POPE, lately with the British Westinghouse Electric and Manufacturing Co., of Trafford Park, to the position of engineer to the hire-purchase and development department. We understand that there are very good prospects for a considerable amount of hire-purchase business in connection with the supply of power from the mains in the company's district.

The South Metropolitan Electric Light and Power Co., Ltd., notify that Mr. WILLIAM MAY, of 18, Austin Friars, has been appointed a director of the company.

On January 10th at Holy Trinity, Killiney, co. Dublin, H. E. O'BRIEN, resident engineer, Liverpool and Southport Electric Railway, was married to Frances, daughter of Captain R. A. Smythe, Court-na-Farraga, Killiney. Presents were received from all the staff of the Liverpool and Southport electrification, Mr. and Mrs. J. A. F. Aspinall (general manager L. & Y. Ry.), Mr. and Mrs. Hoy (general manager Beyer & Peacock), Messrs. G. Flett, W. Rutherford, and P. W. d'Alton.

Obituary.—We regret to learn of the death, from pleurisy, of Mr. EDWARD J. BOILEAU, who has represented Messrs. Falk, Stadelmann & Co., Ltd., for the past 13 years in Ireland. Mr. Boileau had been in indifferent health for the past two or three months, but the seriousness of his complaint was not realised until his admission to the Adelaide Hospital, Dublin, on the 31st ult., where he expired on the 5th inst. The firm will shortly announce the name of Mr. Boileau's successor; they are now making arrangements for a continuance of their representation.

NEW COMPANIES REGISTERED.

Shanghai Electric Tramways, Ltd. (83,109).—This company was registered on January 2nd, with a capital of £10,000 in £1 shares, to acquire, equip, maintain and work by electrical, steam, horse or other power, tramways, railways, boats and other means of communication in Shanghai or elsewhere in Asia, and to carry on the business of electricians, generators, accumulators and distributors of electrical energy for light, heat, motive power or otherwise, &c. The first subscribers (each with one share) are:—H. W. Perry, 1, Hurst Road, Walthamstow, gentleman; A. C. Bate, 9, Fairmount Road, Brixton Hill, S.W., gentleman; J. J. Blackmore, 73, Bryantwood Road, Drayton Park, N., clerk; G. A. Vincent, 79, Crystal Palace Road, East Dulwich, S.E., clerk; M. Carrington, 10, Dempster Road, Wandsworth, S.W., clerk; W. Gilbert, Southport House, Carlton Road, Putney, S.W., clerk; and A. B. Johnson, 66, Limes Grove, Lewisham, S.E., gentleman. No initial public issue. The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first; remuneration as fixed by the company.

General Electric de France, Ltd. (83,156).—This company was registered on January 7th, with a capital of £10,000 in £1 shares, to acquire from L. Espir, on the terms of an agreement between the said vendor, and others of the first and second parts respectively, and N. Gunz of the third part, the entire business of a dealer in electrical apparatus and appliances carried on at 11, bis Rue de Maubeuge, Paris, to adopt a second agreement with the said L. Espir relating to management, and to carry on the business of electricians, electrical, mechanical, sanitary, gas and water engineers, dealers in dynamos, motors, telephones, bells, electroliers, arc and other lamps, electric fittings, heating and cooking apparatus, metals and india-rubber, asbestos and other insulating materials, &c. The first subscribers (each with 5 shares) are:—R. A. E. Poulton, 18, Charlton Road, S.E., solicitor; K. Alwood, 71, Queen Victoria Street, E.C., accountant; J. H. Collings, 71, Queen Victoria Street, E.C., designer; G. Maurice, 71, Queen Victoria Street, E.C., electrical engineer; C. B. H. Robson, 34, St. Helens Road, Westcliffe-on-Sea, accountant; W. E. Curtis, Invergorden, Burton Road, Kingston, accountant; and E. W. Hann, 71, Queen Victoria Street, E.C. No initial public issue. The first directors are L. Espir, H. Hirst, Max Byng and H. Bevis; qualification, £100; remuneration as fixed by the company. Registered office, 67, Queen Victoria Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Supply Co. of Victoria, Ltd. (66,059).—Issue on December 10th of £25,000 5 per cent. debentures, part of series created October 16th, 1900, to secure £200,000. Property charged: The company's undertaking and property, present and future, including uncalled capital; no trustees; previous issue of same series: £75,000.

Moelline Co., Ltd. (electric and general engineers, London) (76,689).—Issue on December 14th of £250 6 per cent. debentures, part of series created March 29th, 1904, to secure £15,000, charged on patents relating to "Moelline," uncalled capital (if any) and the company's general assets, present and future. Holders: City of London Contract Corporation, Tokenhouse Buildings, E.C. No trustees. Previously issued of same series: £13,000.

Sir Hiram S. Maxim Captive Flying Machine Co., Ltd. (80,404).—Debentures created December 17th, and dated December 22nd, 1904, to secure £4,000, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: Sir Hiram S. Maxim, Thurlow Park, West Norwood. An assignment of even date charged on moneys (less ways and actual running expenses) due to become due to the company under an agreement between the London Exhibitions, Ltd., and the Sir Hiram Maxim Electrical and Engineering Co., Ltd, and under an agreement with the Crystal Palace Co., has also been registered, by way of collateral security with the above mentioned debentures.

Chelmsford Electric Lighting Co., Ltd. (36,124).—This company's annual return was filed on December 28th, when 35,000 shares had been taken up out of a nominal capital of £50,000 in £1 shares. £35,000 had been received. Mortgages and charges: £7,870.

Electric Supply Co. of Victoria, Ltd. (66,059).—This company's annual return was filed on December 6th, when 1,207 shares had been taken up out of a nominal capital of £200,000 in £1 shares. £7 has been received, and £1,200 is considered as paid. Mortgages and charges: £75,000. (Note: £25,000 debentures issued since date of return.)

Minehead Electric Supply Co., Ltd. (74,382).—A memorandum of satisfaction in full of a debenture and mortgage dated April 24th, 1903, securing £700, has been filed.

ELECTRICITY SUPPLY ACCOUNTS.

Durban Municipal Electricity Supply.

READERS who make a study of our "South African Notes" column will be well acquainted with the rapid expansion in municipal electrical work in these colonies of late. Of course, in a great many cases, there is no regular rival illuminant in the field, and to this must be attributed some of the phenomenal development which has occurred.

We deal, this week, with the Durban Municipal Electrical Department's returns for the year ending July 31st, 1904. The supply is both on the alternating and direct current systems, from both a new and old generating station, the latter being shortly discarded.

Tramways, private motors and street arc lighting consumed 2,120,549 units of direct current and private lighting, motors, street arc and incandescent lighting, 1,597,126 units on the alternating supply; the total units generated amounting to over 4½ million.

The following figures of progress for five years past will be read with interest:—

	1900.	1901.	1902.	1903.	1904.
Total units sold	433,676	623,440	854,112	2,499,162	3,787,675
Total consumers	545	820	1,115	1,848	2,586
No. of street arc lamps	80	80	82	190	230
No. of street incandescent lamps.. ..	0	150	500	589	902
Total revenue—including tramway current ..	£ s. d. 15,660 10 5	£ s. d. 21,537 0 0	£ s. d. 27,304 2 10	£ s. d. 53,532 13 0	£ s. d. 69,053 19 8
Net profit ..	2,251 0 1	4,350 9 2	5,571 6 2	6,690 2 1	10,914 0 0

The most noticeable increases in supply, compared with the previous year, are for motors, which consumed (including Corporation motors) 680,901, as compared with 229,236 units at July, 1903, and in connection with which it is noted that the almost universal use of the electric motor leads to atmospheric conditions not usually associated with manufacturing centres, such as Durban. In private lighting, some 39 per cent. additional consumers have been added, and 23 per cent. additional units supplied.

We take this opportunity of congratulating the engineer, Mr. John Roberts, on the unique opportunities, which he certainly has not neglected, of developing so promising a field of electric supply.

The prices charged are:—For private lighting, 8d. per unit up to 500, with 15 per cent. discount beyond; motors 2d. per unit, and £5 per H.P. installed, per annum.

General Statement for Year ended July 31st, 1904.

Capital expended	£219,648
Number of units sold:—	
Private lighting	1,361,754
Power	680,901
Traction	1,343,385
Public lighting	401,635
Total number of units supplied	3,787,675
Equivalent number of 8-C.P. lamps connected	100,000
Number of public lamps	230 arc 902 inc.
H.P. of motors connected	1,000

Revenue Account.

Gross revenue	£69,052 =	4·36d. per unit
Gross expenditure	£38,264 =	2·42d. „
Gross profit	£30,788 =	1·94d. „
Average price obtained per unit:—		
Private supply		5·85d.
Public lighting		3·64d.
Traction		1·75d.

Profit Statement.

Interest on loans	£7,725
Depreciation	6,400
Special allowance (Point plant)	5,750
Balance on year's working	10,913
Gross profit	£30,788

CITY NOTES.

Cleveland and Durham County Electric Power Co.—An extraordinary general meeting of the company will be held at Middlesbrough on the 18th inst. for the purpose of creating the sum of £156,000 debenture stock, bearing interest at the rate of £5 per cent. per annum, being part of the £333,333 which the company is empowered to borrow under Section 6 of the Act of 1903.

Direct United States Cable Co.—The board have resolved upon the payment of an interim dividend of 3s. per share (at the rate of 3 per cent. per annum), for the quarter ending December 31st, 1904, such dividend to be payable on and after the 31st inst., setting aside £10,000 to reserve fund account, and carrying forward a balance of about £2,876.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in a further issue of 10,000—6 per cent. cum. pref. shares of £5 each, fully paid, in Edmundson's Electricity Corporation.

Globe Telegraph and Trust Co.—The directors have declared an interim dividend of 2s. each on the ordinary shares.

Chili Telephone Co.—The directors have declared an interim dividend of 3s. per share, payable on the 16th inst.

STOCKS AND SHARES.

Wednesday Evening.

The disappointment at the slow way in which business moves towards the Stock Exchange, of which mention was made here last week, is still in vogue. The markets are insipid and somewhat slack. For all the cheapness of money, the gilt-edged departments look with no kindly eye upon the various new issues which are in the air. Investors prefer to retain their bank-balances intact so long as the foreign uncertainty prevails. Russia is having to pay a very tall price, considering the country's credit, for her latest loan, and manifestly Japan's new Internal issue will not go far in providing fresh sinews of war. All these things act and react upon other markets, but still the electrical sections keep firm in spite of the prevailing dulness elsewhere.

National Telephone Deferred provides the sensation of the week. The price has been up to 115 since our last notes were written, and at 113 it shows a rise of 10 points on balance. The jump was brought about, of course, by circulation of rumours that the Government were on the point of concluding an arrangement with the company whereby the Deferred stock would be paid off at 120. The rumour carried contradiction upon the face of it, but that there is some groundwork for supposing the negotiations to be nearing conclusion is equally manifest. What caused so sharp a rise was the scarcity of floating stock in the market. Dealers who were bidding for Telephone Deferred on the day the quotation went to 115, offered prices at a rise of a point at a time, without securing any stock. The market quickly lapsed to 108 when a few sellers came along, as they did as soon as the boomlet became known, but the price rallied again. The Preferred stock is unchanged, the third Preference shares are ¼ better at 5⅝, while in the case of the two Debenture issues, a fall of 10s. has occurred in the price of each.

Railway dividends are now a favourite subject for discussion, and the forecasts do little to help quotations. City and South London Ordinary has lost half its last week's rise, and is down to 46½. Central London Deferred has, however, added a point at 86, upon the view that the stock is priced at a level which allows liberal margin for the discounting of Underground competition. Great Northern and City Preferred "A" shares have risen ¼ to 6½. Districts continue at 40, but Metropolitan eased off to 98, due partly to the slight mishap to an electrified train, partly to the knowledge that still more capital must be raised before long. London and Brighton stocks have been a firmer market, it being thought that the forthcoming experiments in electrifying portions of the line will lead to extensive development of the traffic.

Further buying in the Argentine Tramway market has put Anglo-Argentine Ordinary up to 8¼, and the price is confidently talked to 10, while the dividend is estimated at 10 per cent. The Preference are 5⅝, and the Debenture stock is 141½, both being *ex* dividend. Buenos Ayres and Belgrano are again $\frac{3}{16}$ harder at 4; City of Buenos Ayres shares have been taken out of the Stock Exchange Official List until the new shares shall be ready for quotation. Buenos Ayres National First Preference are in strong demand, it being said that holders will shortly receive a very handsome payment on account of interest in arrears, but there are no shares to be obtained in the market. British Electric Traction Ordinary are ¼ up at 10 and the Preference at 11⅛ have advanced to the extent of the fraction. There is a fair inquiry noticeable for London United Trams; the Preference are 10½ and the Debenture stock 104, both of these being also *ex* dividend. British Westinghouse Preference were done at 2$\frac{13}{16}$ on Tuesday. Calcutta Trams rose to 8½, and Cape Electrics are harder at 1$\frac{5}{16}$ upon rather knowing buying.

In neither the Electric Supply nor Telegraph sections are there many quotable changes. Amongst the seven rises in the former, the principal is one of 5s. in City of London Ordinary, and a similar sum in Westminster Preference shares. Edmundson's maintain their tendency to advance, with ½ rise at 6⅜, and the other improvements consist of 1 per cent. additions to the prices of several Debenture stocks. United River Plate Electric Preference have come in for some attention, these 6 per cent. shares standing between ⅞ and 1. They may have been overlooked in the rush for Argentine investments, but naturally they fall within a speculative area. Brush Ordinary rose $\frac{1}{16}$ to 1$\frac{7}{16}$, and the Second Debenture is a point better at 74½.

Much gambling in Anglo-American Deferred has left the price at 13⅜, which shows no alteration on the week. The company's dividend announcement should be made in about a fortnight's time, but the Deferred will certainly get nothing for the past year; the Preferred fell back to 104. Beyond a 1 per cent. recovery in Commercial Cable Debenture, the telegraph list is without interest so far as changes go, and the Trust Co.'s stocks remain motionless. An interim dividend of 2s. has been declared on Globe Ordinary shares. Of the excitement in National Telephones we have already spoken. Monte Video Telephone shares at ⅞ are a shade better.

In the manufacturing list the feature is a rise of 35s in British Aluminium Preference, which are in strong demand and very short supply. India-Rubbers stay at 15½, but British Insulated lost 5s. at 5¼. Cromptons are still wanted, a $\frac{5}{16}$ rise taking the price to 2½, and this section, as a whole, keeps very steady.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Jan. 4th.	Closing Quotations Jan. 11th.	Business done week ended Jan. 11th, 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102 xd	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	¼— 1	¼— 1	⅞	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	57 — 59	57 — 59	57	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	104 —105	103¾— 104½	104½	103¾
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	13/16— 13/16	13/16— 13/16	13/16	12 13/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5⅞— 6⅛	5⅞— 6⅛	5 13/16	..
13,888,800$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 94 xd	93 — 95	94½	94
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	8½— 9½	8½— 9½	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16 7/16— 17 7/16	16 7/16— 17 7/16	..	..
12,981	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7¾— 8¼	7¾— 8¼	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 — 102	100 —102	..	..
60,710‡	Direct United States Cable	20	3½%	3½%	3 %	10½ — 11	10½ — 11	11	10½
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,300, Red.	100	..	..	..	101 —103	101 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	135 —138	135 —138	137½	135½
1,955,565	Do. 5½ % Pref. Stock	100	..	..	..	88 — 90	88 — 90	89⅛	89⅜
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	106⅜	105⅜
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13½— 14	13½— 14	13⅝	13⅜
320,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	..	..
200,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	101¼	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	101	100
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	10½— 10½	10½— 10½	10½	10½
180,042	Do. do. 5 % Pref.	10	..	..	..	14 — 14½	14 — 14½	..	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28½ — 29	28½ — 29	..	..
50,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101 xd	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44½— 46½	44½— 46½	45⅞	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	2½%	3 %	3 %	⅜— ½	⅜— ½	½	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	108½ —109½	108½ —109½	109⅜	108
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	102 —104	112 —114	113½	103
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	13¾	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 5/16— 5 7/16	5¼— 5⅜	5⅜	5 5/16
000,000‡	Do. do. 5½ % Deb. Stock Red.	Stock	5½%	5½%	5½%	96 — 98 xd	96 — 98	97½	96½
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101½—103½xd	101 —103	102½	101⅝
1,000,000	Do. do. Prov. Certs., all paid	..	..	..	..	101½—103½xd	101—103	101½	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	1 — 1⅛	1 — 1⅛	..	..
50,000	Do. do. 6 % Cum. Pref.	1	..	..	..	1⅛— 1⅛	1⅛— 1⅛	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	96 — 99 xd	96 — 99	..	..
11,889	Reuter's	8	5 %	5 %	..	7 — 7⅛	7 — 7⅛	7⅛	..
8,808	Submarine Cables Trust	Cert.	..	..	..	120 —123	120 —123	122½	121½
56,000	United River Plate Telephone	5	7 %	7 %	..	6¼— 6⅜xd	6¼— 6⅜	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5⅛xd	5 — 5⅛	..	..
172,947‡	Do. do. 5 % Debs.	Stock	..	..	..	104 —106 xd	104 —106	105½	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	7⅛— 7⅜	7⅛— 7⅜	..	..
80,008	West Coast of America, 1 to 80,000 and 53,001 to 53,009	2½	..	..	..	1/16— 1/16	1/16— 1/16	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	97 — 99 xd	97 — 99	..	..
267,280	Western Telegraph, Ltd., Nos. 1 to 207,280	10	7 %	7 %	7 %	13½— 14	13½— 14	13 13/16	13⅝
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —103 xd	101 —103	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —102 xd	100 —102	..	..
86,321	West India and Panama Telegraph	10	..	..	..	⅝— ¾	⅝— ¾	..	..
94,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅛— 7⅜	7⅛— 7⅜	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6¾— 7¼	6¾— 7¼	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	101 —103 xd	101 —103	101¾	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	6 — 6½xd	7⅜— 8⅛	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	9 — 9¼	9 — 9¼	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 —100	96 — 100	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅛— 10 xd	9⅜— 10⅛	10⅛	9⅞
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅞— 11⅛	11 — 11⅛	11 3/16	11
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	118 —120	118 —120	118½	..
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	95 — 97	98	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅛— 5⅜	5 — 5⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
80,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104 xd	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅜— ½	⅜— ½	..	..
50,000	¶ Do. do. 5 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	⅜— ½	⅜— ½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1⅛— 1⅜	1 3/16— 1 7/16	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	72 — 75 xd	73 — 76	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10	9½— 10	9⅝	9½
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	103 —105 xd	104 —106	104	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	91 — 93	91 — 93	..	..
494,068	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102	..
494,968	Do. do. Def. do.	Stock	4 %	4 %	4 %	84 — 86	85 — 87	86½	..
1,830,000	City and South London Railway	Stock	2 %	3½%	2½%	46½ — 47½	45½— 46½	47½	47
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅞— 2	2 — 2¼	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	98 — 98 xd	98 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..
844,033‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82 xd	77 — 82	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	2	6 %	6 %	4 %	1½— 1¾	1½— 1¾	..	..
81,290	Do. do. 7 % Cum. Pref., 1 to 81,290	2	..	..	..	2½— 2⅝	2½— 2⅝	..	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —100	98 —100	..	..
35,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20%	20 %	15 %	10½ — 10⅝	10½ — 10⅝	10⅝	10½
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅜— 5⅝	5⅜— 5⅝	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	110 —112	110 —112	110½	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15 — 16 xd	15 — 16	15 1/16	15
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	99⅛	..
97,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3 1/16— 3 3/16	3 1/16— 3 3/16	..	..
10,000	Do. do. Pref. £10 paid	10	..	..	..	10 — 10⅛	10 — 10⅛	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	38 — 40	38 — 40	38½	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101½—103½	101½—103½	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	8 %	5½%	5½%	90 — 92	90 — 92	91	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully aid. ¶ From Manchester Share List.

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued). – ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Jan. 4th.	Closing Quotations Jan. 11th.	Business done week ended Jan. 11th, 1905. Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8%	8 %	10 %	10½ — 11	10½ — 11	10⅝	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10½ — 10⅝	10½ — 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	104 —107	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	8½ — 8⅝	8½ — 8⅝	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5⅜	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4 15/16 — 5 xd	4 15/16 — 5	4 15/16	..
40,000	Do. do. 1903	5	..	..	..	4⅞ — 5	4⅞ — 5	5	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —103	101 —103	102½	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5⅛%	6⅝ — 6⅞	6⅝ — 7	6⅞	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —109 xd	108 —110	109½	109
70,695	City of London Electric Lighting, Ord. 40,001—110,695 ..	10	5 %	5 %	5 %	10⅝ — 11¼	11 — 11⅛	11¼	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13¼ — 14	13½ — 14	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	£	..	..	..	121 —125 xd	121 —125	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —103 xd	101 —103	101½	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	9 — 9¼	9 — 9¼	9¼	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	10	..	..	..	12 — 12⅞	12 — 12⅞	12 5/16	..
400,000£	Do. do. 4½% Deb. Stock	£	..	..	..	106 —109 xd	107 —110	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —103	101 —103	102	100⅞
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6⅛ — 6⅜	6⅜ — 6⅝	6 5/16	6 1/16
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6¼	6 — 6¼	6⅛	..
300,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	£	..	..	..	108 —110	108 —110	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12%	12¼ — 13	12½ — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	8	..	..	..	2 1/16 — 2 3/16	2 1/16 — 2 3/16	..	..
42,840	Do. do. do. 6 % Pref.	5	..	..	..	5 1/16 — 5 1/8	5 1/16 — 5 1/8	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 — 97	95 — 97	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¾%	7¼%	8⅜%	18 — 18½	18 — 18½	18⅝	18 1/16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5 7/16 — 5 9/16 xd	5 7/16 — 5 5/16	..	..
230,000£	Do. do. 4½% 1st Mort. Deb. Stock	£	..	..	..	110 —115 xd	110 —115	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 98 xd	96 — 98	96½	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	14½ — 15	14½ — 15	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	102 —104	102 —104	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	13¾ — 14	13½ — 14	13 13/16	13¾
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	..	..	..	8¾ — 9	8½ — 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —100 xd	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2⅜%	4 %	2¾ — 3⅛	2¾ — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
66,000	South London Electricity Supply, Ord.	5	..	12⅜%	8 %	4⅛ — 4⅜	4⅛ — 4⅜	4 7/16	4 7/16
100,000	South Metropolitan Electric Light and Power Ord. ..	1	..	..	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..
50,000	(Late Blackheath and Greenwich 7 % Pref.	1	..	..	..	1 3/16 — 1 7/16	1 3/16 — 1 7/16	..	..
100,000	Dist. E.L.Co.) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5⅛	5 — 5⅛	5 5/32	..
80,000	Do. 5 % Cum. Pref	5	..	..	..	5 1/16 — 5 3/16	5 1/16 — 5 3/16	..	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	..	104 — 106	104 — 106	106	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12⅜ — 13½	12⅜ — 13½	13⅛	13
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛ xd	6⅛ — 6⅜	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, January 11th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.		5/-	..
a " Nitric .. .. per cwt.		22/-	..
a " Oxalic .. .. per cwt.		32/-	..
a " Sulphuric .. .. .. per cwt.		5/6	..
a Ammoniac, Sal .. .. .. per cwt.		42/-	..
a Ammonia, Muriate (crystal) .. per ton		£38 10	..
a " .. .. per ton		£30	..
a Bleaching powder .. .. .. per ton		£5 5	..
a Bisulphide of Carbon .. .. per ton		£15	..
a Borax .. .. per ton		£18	..
a Benzole (90 %) .. .. .. per gal.		7/-	..
a " (50/90 %) .. .. .. per gal.		5/6	..
a Copper Sulphate .. .. .. per ton		£23	..
a Lead, Nitrate .. .. .. per ton		£25	..
a " White Sugar .. .. .. per ton		£31	..
a " Peroxide .. .. .. per ton		£27 10	..
a Methylated Spirit .. .. .. per gal.		2/6	..
a Naphtha, Solvent (90% a 160° C). per gal.		5/6	..
a Potash, Bichromate, in casks .. per lb.		8d.	..
a " Caustic (76/80%).. .. per ton		£19	..
a Shellac .. .. per cwt.		165/-	35/- dec.
a Sulphate of Magnesia .. .. per ton		£4 10	..
a Sulphur, Sublimed Flowers .. per ton		£6 10	..
a " Recovered .. .. per ton		£5 10	..
a " Lump .. .. .. per ton		£5	..
a Soda, Caustic (white 70 %) .. per ton		£10 15	..
a " Crystals .. .. .. per ton		£8	..
a " Bichromate, casks.. .. per lb.		3½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots .. per ton		£130	..
b " Wire, in ton lots .. per ton		£168	..
b " Sheet, in ton lots .. per ton		£166	..
b Babbitt's metal ingots .. .. per ton		£48 to £140	..
c Brass (rolled metal 2" to 12") basis per lb.		7¼d.	..
c " Tube (brazed) .. .. per lb.		9½d.	..
c " " (solid drawn).. .. per lb.		8¼d.	..
c " Wire, basis.. .. .. per lb.		7¾d.	..
c Copper Tubes (brazed) .. .. per lb.		10d.	..
c " " (solid drawn) .. per lb.		10½d.	..
c Copper Bars (best selected .. per ton		£80	..

METALS, &c. (continued).

		Latest Price.	Week's Dec. or Inc.
g Copper Sheet .. .. .. per ton		£80	..
g " Rod .. .. per ton		£80	..
g " (Electrolytic) Bars .. per ton		£70 10	..
g " Sheets .. per ton		£87	..
g " " Rod .. per ton		£81	..
g " " H.C. Wire per lb.		9⅜d.	¼d. inc.
f Ebonite Rod .. .. .. per lb.		8/8	..
f " Sheet .. .. .. per lb.		8/-	..
m German Silver Wire .. .. per lb.		1/6	..
h Gutta-percha fine .. .. per lb.		8/-	..
h India-rubber, Para fine .. .. per lb.		5/1½ to 5/2½	inc.
i Iron, Charcoal Sheets .. .. per ton		£18	..
i " Pig (Cleveland warrants) per ton		49/3	1/9 dec.
i " Forgings, according to size per ton		From £11	..
i " Scrap, heavy .. .. per ton		47/6 to 50/-	..
i " Wire, galvanised No. 8 .. per ton		£9 15	..
g Lead, English Ingot .. .. per ton		£13 2 6 to £13 5	..
g " " Sheet .. .. per ton		£14 7 6	2/6 dec.
m Manganin Wire No. 28 .. .. per lb.		8/-	..
g Mercury .. .. per bot.		£7 15	..
d Mica (in original cases) small .. per lb.		6d. to 1/	..
d " " " medium per lb.		2/6 to 4/-	..
d " " " large .. per lb.		4/6 to 8/6	..
p Phosphor Bronze, plain castings per lb.		1/0¼ to 1/3	..
p " rolled bars & rods per lb.		1/0½ to 1/3	..
p " " strip & sheet per lb.		1/2	..
o Platinum .. .. per oz.		81/6	..
e Silicium Bronze Wire .. .. per lb.		10d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n per ton		£68	..
i " " in bars		£15 to £40	..
g Tin, Block .. .. per ton		£132 to £133	10/- dec.
n " Wire, Nos. 1 to 16 .. .. per lb.		1/7½	½d. dec.
p White Anti-friction Metals—			
"White Ant" brand .. per ton		£43 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.		8d.	..
j " 6 lea. Flax .. .. .. per lb.		6¾d.	..
j " 3 ply 10 lbs. Russian .. per lb.		4 15/16d.	..
j " 10 lbs. Russian, single .. per lb.		4¾d.	..
j " 160 lbs. Jute rove .. per ton		£11	..
k Zinc, Sh't (Vieille Montagne bnd.) per ton		£29 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Jan. 7	1,533	+294	32	45,659	+ 5,801	10	—
Bath	" 4	569	+178	1	569	+ 178	12½	—
Birmingham	" 7	5,548	+497	1	5,543	+ 497	8½	—
Blackburn	" 9	788	+ 1	36	34,879	+ 3,334	13½	—
Blackpool	" 5	336	+ 49	40	43,849	+ 5,995	8½	—
" —Fleetw'd	" 7	180	— 8	1	180	— 70	7½	—
" —Lytham	Dec. 29	137	— 38	9	1,109	—	7½	+ ¾
Bolton	Jan. 8	2,151	+185	41	75,565	+ 448	25	—
Bournemouth ..	" 4	978	+116	40	44,184	—	10½	—
Bradford	Dec. 17	3,729	+363	35	169,463	+27,081	54	—
Brighton	Jan. 8	797	+ 54	40	41,250	—	9	—
Bristol	" 6	4,579	+181	—	—	—	28	—
Devonport ..	Dec. 30	586	+ 79	52	27,439	+ 3,287	5	—
Dudley—Sto'rb'ge	" 30	955	+ 89	52	44,782	+ 1,324	18½	—
Gateshead ..	" 30	976	— 33	52	47,508	+ 1,192	10½	+ ¾
Gr'n'k—Pt. Glsgw	" 30	490	— 31	52	29,722	+ 1,434	7½	—
Oldham—Ashton	" 30	517	— 26	52	28,202	— 1,298	5	—
Potteries	" 30	1,924	+376	52	89,571	+ 6,203	26½	—
South Staffs. ..	" 30	821	—365	52	39,468	— 9,082	21¼	—¾
Swansea	" 30	656	+101	52	27,994	+ 864	5½	—
Wolverhampton..	" 30	466	— 43	52	20,195	— 50	10½	+6
Yorks. Wool Dist.	" 30	693	+ 38	52	30,131	+ 8,858	6	—
Miscellaneous ..	" 30	3,359	—	52	182,137	—	—	—
Burnley	Jan. 7	1,090	+274	—	—	—	10½	+2½
Burton-on-Trent ..	" 2	344	+ 24	39½	13,616	—	6½	—
Cardiff	Dec. 31	2,118	+330	39	80,693	+ 1,978	14	
Chatham & District	Jan. 5	388	—147	1	388	— 107	9·33	+·80
Cork	" 5	805	—110	1	805	— 110	8·89	—
Dover	" 7	181	+ 9	1	181	— 62	8	—

* Compared with the corresponding period of 1903.

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Dublin	Jan. 6	3,915	+182	1	3,915	+ 111	47	—
East Ham	" 7	628	+ 44	40	28,920	+ 1,564	6½	—
Glasgow	" 7	17,069	+ 2450	32	457,766	+ 22,468	72½	+ 3
Halifax (2 weeks) ..	Dec. 28	2,498	+121	39	57,844	+ 4,192	34½	+ 3
Huddersfield ..	Jan. 7	1,219	+125	40	55,814	+ 3,543	28	—
Hull	" 7	2,180	+143	40	88,496	+10,763	13	—
Ilkeston	" 4	91	— 14	40	5,501	— 397	3·5	—
Ipswich	" 7	338	— 3	40	19,460	—	10½	—
Isle of Thanet ..	" 7	214	— 8	1	214	— 8	10½	—
Leeds	" 7	5,293	+ 495	41	236,384	+ 13,446	89½	+ 8½
Liverpool	Dec. 31	10,377	+ 681	52	540,916	+ 16,407	103	—
London C. C. ..	" 24	11,643	+ 1988	38	488,717	+ 105897	47½	+ 7½
Manchester	Jan. 7	11,996	+ 1247	40	491,433	+ 20,864	137½	+ 19½
Newcastle	" 7	3,7 4	+ 272	—	—	—	17	—
Portsmouth	" 7	1,515	+ 143	41	78,952	+ 6,232	14½	—
Salford	" 2	4,088	+ 104	39	161,274	+ 7,708	30	—
Sheffield	" 8	4,567	+ 529	41	192,194	+ 4,691	34½	+ 1½
Southampton	" 5	859	+ 14	40	39,516	— 2,302	16½	—
Southend-on-Sea ..	Dec. 28	223	+ 25	39	14,416	+ 1,430	6½	—
Sunderland	" 18	1,116	+ 44	37	47 804	+ 1,092	21	+ 1
Tyneside	Jan. 4	208	— 44	1	208	— 44	8·9	+ ·4
West Ham	" 5	1,076	—	45	43,115	—	9·78	—
Wolverhampton ..	" 4	732	+ 294	—	—	—	9·5	—
Cen. London Rly. ..	" 7	7,015	— 39	1	7,015	—	6	—
City & S. Lon. Rly.	" 8	3,179	+ 46	2	6,400	— 5	6½	—
Dublin—Lucan Rly.	Dec. 31	158	— 18	26	3,278	— 17	6½	—
G. N. and City Ry.	Jan. 7	1,555	—	—	—	—	3½	
L'pool Overh'd Rly.	" 8	1,505	— 93	2	2,938	— 223	6½	+ ½
Metrop. Railway ..	" 7	1 664	+ 94	1	—	—	4½	—

THE ELECTRA STEAM TURBINE.

By WALTER RAPPAPORT.

If one guides the steam which leaves the moving wheel of a steam turbine with still rather high velocity by means of guide blades over to a second moving wheel, and so on, till the entire steam energy is used up, these moving wheels may revolve with a low circumferential speed. This is the way in which Curtis and Riedler-Stumpf constructed slow-running turbines with good steam economy. A similar, but somewhat simpler method, is employed by the Gesellschaft für Elektrische Industrie, of Karlsruhe, Germany, in their Electra turbine.

They guide the steam which leaves the moving wheel by means of reversing blades back to the *same* wheel, utilising thereby a further portion of the kinetic energy, and they repeat this process four or five times. In fig. 1 the cross-section, and in fig. 2 the longitudinal section of the Electra turbine, are represented. The steam enters the turbine through pipe *a*, and flows through an annular channel round about the casing, thus acting as a steam jacket; then, flowing into the nozzles, *p*, it expands there, and acts upon the moving wheel for the first time. As the nozzles lie along the outer circumference of the wheel the steam flows towards the inside, is led back to the wheel by reversing blades, *g*, flows thereupon to the outside, and so forth, till it enters an annular channel through

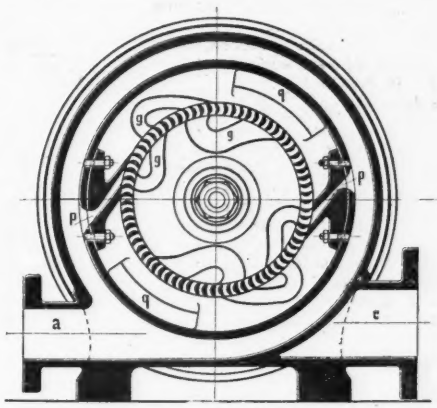


Fig. 1.

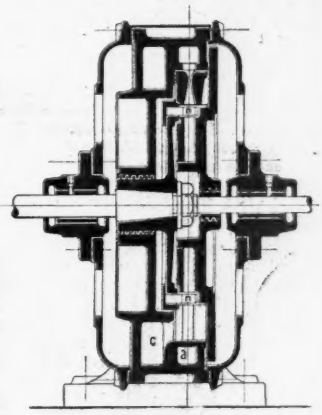


Fig. 2.

the opening, *g*, from whence it goes to the condenser through pipe *c*. In accordance with the decrease of the steam velocity the steam channels, *g*, grow wider.

The steam flows around the moving wheel in the same direction in which the latter rotates, so that only a very slight deviation of the current of the steam takes place during its passage through the turbine. It would appear to be better to guide the steam in a contrary direction, as then the current of the steam would always deviate in the same direction, and the steam flowing along the curved surface of the blades, which is under higher pressure in consequence of the centrifugal force, would not mix with the other steam.

The moving wheel is forged of ordinary iron, or consists of steel as well as the blades. The latter are inserted singly, as in the Parsons turbine, and are held fast by an encircling hoop. Up to a capacity of 100 H.P. the Electra turbine is furnished with only one moving wheel, and above that capacity with two wheels. As the circumferential speed of the wheel need be but moderate, about 60 to 100 m. per sec., the diameter of the same may be small, though there are only low numbers of revolutions. For instance, in a 50-H.P. turbine with 3,000 r.p.m., the diameter is only 525 mm., *i.e.*, about 21 in. The number of blades in the same turbine is only about 400, whereas in the Parsons turbines the blades are counted by thousands. The consumption of steam in this Electra turbine amounts to 22 lb. per B.H.P.-hour, with a vacuum of 28 in.

The number of revs. per minute in the Electra turbine varies from 4,000 in a 10-H.P. turbine to 2,500 in a 100-H.P. turbine. Fig. 3 shows the 50-H.P. turbine taken apart. To the left (background) is the casing with the two expansion nozzles, next to it the cover, and in front the moving wheel with the shaft. In fig. 4 a view of a 10-H.P. turbine is shown, and by comparing this with the scale shown in front, it is easily seen that the Electra turbine takes up only as much room as a Laval turbine *without* gear box, although even smaller units of the Electra turbine run at moderate speeds.

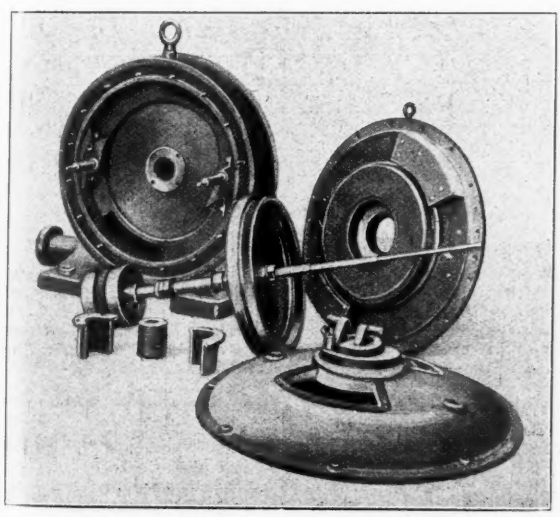


Fig. 3.

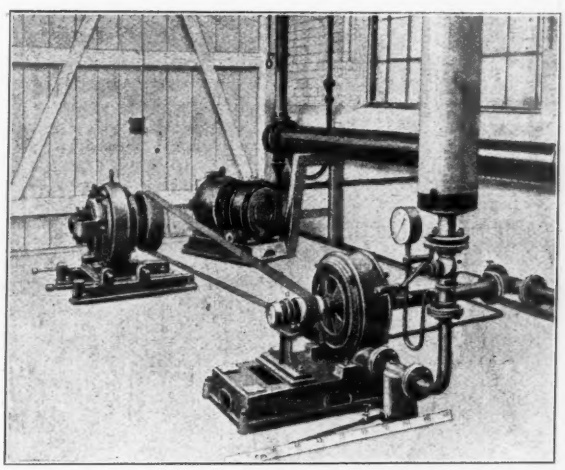


Fig. 4.

Electrical Trade in America.—The present position of American electrical industry is referred to as follows by New York *Electricity*:—"With no menacing cloud in the business horizon, there would seem to be no reason why the year 1905 should not be an excellent one from a financial standpoint for electrical manufacturers, dealers and contractors. In this vicinity alone there are large electrical undertakings hanging in abeyance, which will shortly require an immense amount of machinery and apparatus, and the services of many electrical experts."

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"G. S." writes:—"Is the Borough Council responsible for loss of wages of men which are wasted through their having to stand idle owing to a failure of the electrical supply?"

*** The question raised by "G. S." is one of some interest, which must often trouble the minds of persons who are solely dependent on the public supply of electricity. It does not seem to be competent for a consumer who suffers from the failure of a supply of electricity to bring an action. This is because the Electric Lighting (Clauses) Act of 1899 makes provision for the purpose of meeting such a contingency. It is there provided that "Whenever the undertakers make default in supplying energy to any owner or occupier of premises to whom they may be and are required to supply energy under their order, they shall be liable in respect of each default to a penalty not exceeding 40s. for each day on which any such default occurs. . . . . Provided that the penalties to be inflicted on the undertakers under this section shall in no case exceed in the aggregate the sum of £50 in respect of any defaults, not being wilful defaults, on the part of the undertakers for any one day, and provided also that in no case shall any penalty be inflicted in respect of any default if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply." We anticipate that the proviso will generally be construed favourably to the supply company; but if, as we anticipate, our correspondents can show that they suffered material damage, they might make a successful application for penalties. It should be remembered, however, that the undertakers are not responsible for the consequences of "inevitable accident." In a case decided some years ago, the undertakers were able to show that a breakdown was caused by the mains having "perished" through being made of defective material. This was held to be sufficient to excuse the company.

INSTITUTION OF ELECTRICAL ENGINEERS.

STAND-BY CHARGES AND MOTOR LOAD DEVELOPMENT.

By A. M. TAYLOR, Member.

(*Abstract of Paper read at Birmingham, December 14th, 1904.*)

IT will readily be conceded—at any rate among electrical engineers—that it is very essential, if a motor load of any magnitude is to be secured by electric supply concerns, that it should be secured *at once*.

"*Continuous*" *v.* "*Intermittent*" *Motor Loads.*—Let us consider for a moment whether it is possible to tempt consumers having the continuous class of load to come on to the mains by offering an attractive rate—say 1d. per unit—and making up for a possible deficiency of profit by taxing the intermittent class of motors with a higher rate—say 2d. per unit. Such a method of charging has the valuable property, that it emphasises the difference between the two classes of load, and attracts consumers by the low rate for the more favoured class. On the other hand, unless the lower rate offered is such as to show economy over gas or oil, few consumers will be added of the class most sought for, while some of the intermittent class of consumers will probably be lost, who might otherwise have been gained.

The author is also very doubtful whether such a low rate as 1d., unaccompanied by restrictions, will pay in the majority of purely lighting stations, even when coupled, as it should be, with the condition of a high load factor.

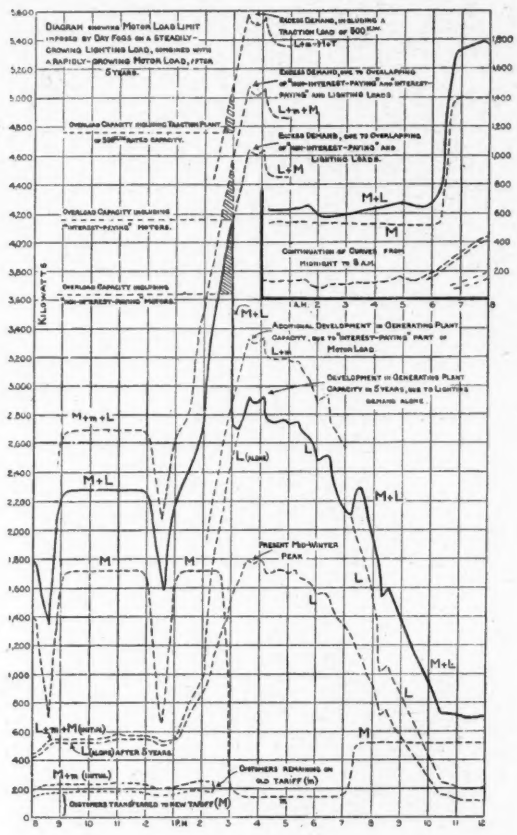


DIAGRAM showing MOTOR LOAD LIMIT imposed by DAY FOGS on a STEADILY-GROWING LIGHTING LOAD, combined with a RAPIDLY-GROWING MOTOR LOAD, after 5 YEARS.
EXCESS DEMAND, DUE TO OVERLAPPING OF "NON-INTEREST-PAYING" MOTOR LOAD AND STAGNATED LIGHTING LOAD.
MOTOR LOAD DEVELOPMENT TAKEN AT 60% PER ANNUM OVER 4 YEARS.
OVERLOAD CAPACITY (LIMIT) OF EXISTING PLANT.
RATED CAPACITY OF EXISTING PLANT.
PRESENT MID-WINTER PEAK.
KILOWATTS.
MOTORS (INITIAL) DAILY DAY LOAD.
CUSTOMERS REMAINING ON OLD TARIFF.
CUSTOMERS TRANSFERRED TO NEW TARIFF.

FIG. 2.

DIAGRAM showing MOTOR LOAD LIMIT imposed by DAY FOGS on a STEADILY-GROWING LIGHTING LOAD, combined with a RAPIDLY-GROWING MOTOR LOAD, after 5 YEARS.
EXCESS DEMAND, DUE TO A TRACTION LOAD OF 500 K.W.
EXCESS DEMAND, DUE TO OVERLAPPING OF "NON-INTEREST-PAYING" AND "INTEREST-PAYING" AND LIGHTING LOADS.
OVERLOAD CAPACITY INCLUDING TRACTION PLANT, OR SHORT-RATED CAPACITY.
OVERLOAD CAPACITY INCLUDING "INTEREST-PAYING" MOTORS.
CONTINUATION OF CURVES FROM MIDNIGHT TO 8 A.M.
OVERLOAD CAPACITY INCLUDING "NON-INTEREST-PAYING" MOTORS.
ADDITIONAL DEVELOPMENT IN GENERATING PLANT CAPACITY, DUE TO "INTEREST-PAYING" PART OF MOTOR LOAD.
DEVELOPMENT IN GENERATING PLANT CAPACITY IN 5 YEARS, DUE TO LIGHTING DEMAND ALONE.
PRESENT MID-WINTER PEAK.
CUSTOMERS REMAINING ON OLD TARIFF (m)
CUSTOMERS TRANSFERRED TO NEW TARIFF (M)
KILOWATTS.

FIG. 1.

Take, for instance, the case of a lighting station of the ordinary type in any moderate-sized town, and let it be granted that the overlapping of the motor and lighting loads necessitates extra plant and mains being put down. Assume, further, that *all* the motor load consists of the class of motor under consideration at the time. Then—

CASE 1.—*Motor Continuously Loaded to its Full Output.*

For nine hours per day (say 50 hours per week). Average load of motor = 1 H.P. = 0·90 KW. at consumers' terminals. Hours of running per quarter = 650. Diversity factor = 1. Units per H.P. installed per quarter = 585. 1 KW. at motor = £70 additional capital outlay at station. Interest and sinking fund (at 7 per cent.) = 0·45d. per unit.

Add office expenses, say 0·05d.; rates, rent and taxes, say 0·03d.; also net profit, say 0·10d. per unit, and we get a total, exclusive of depreciation or of works costs, of 0·63d. per unit. About depreciation the author forbears to say anything, as it is rather a vexed question; but, as to works cost, let us assume the excellent figure of 0·70d. per unit (= 0·63d. per H.P.), and we get a total cost to the consumer of 0·63d. + 0·70d. = 1·3d. per unit.

Even this does not reach a "bed rock" price of 1d. per unit, which would only be warranted where the "works cost" was as low as 0·4d. per unit, and then only in the case of motors consuming at least 585 units per H.P. installed per quarter.

CASE 2.—*Motor Intermittently Loaded with Varying Loads.*

Maximum load = 1 H.P. = 0·90 KW. at consumers' terminals. Average load = ½ H.P. during hours of running = say ½ KW. Hours of running per quarter = 325. Units per H.P. installed per quarter = 162. 1 KW. at motor

= £70 additional capital outlay. Interest and sinking fund (at 7 per cent.) = $\frac{1{\cdot}81\text{d. per unit}}{\text{Diversity factor}}$. Diversity factor = anything between 1 and 4 = say 1·5 as a safe figure. Hence, revised interest, &c., charge = $\frac{1{\cdot}81^{d}}{1{\cdot}5}$ = 1·21d. per unit. Add office expenses, say 0·10d.; rates, rent and taxes, say 0·05d.; profit, say 0·15d. Total, exclusive of "works cost" = 1·51d. per unit.

Add "works cost" = 0·70d. × 1¼ (on account of diversity factor) = say 0·90d. per unit.

Total cost, exclusive of depreciation = 2·41d. per unit.

The above is for the case of a consumption of 162 units per H.P. installed per quarter, corresponding to an average of one-fourth of the H.P. installed during the nine working hours of the day; a figure not greatly above the average in manufacturing towns—in some cases even below it.

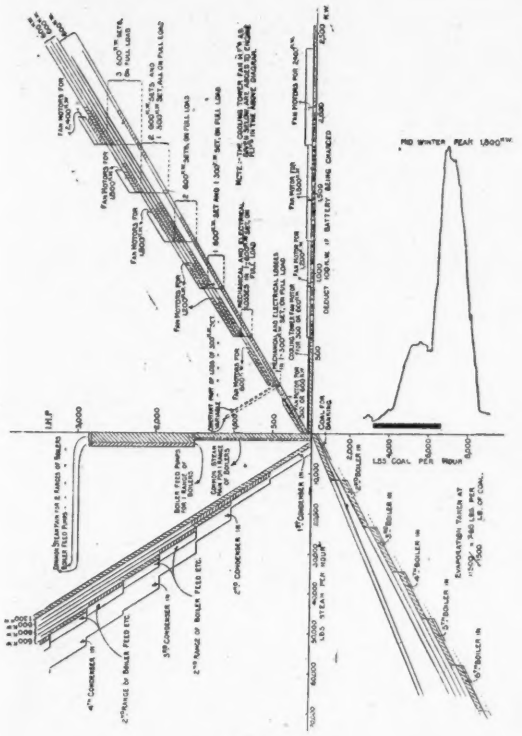


FIG. 3.

"Non-Interest-Paying" Motor Load. — The author desires, in the present paper, to emphasise the suggestion that it would seem to be impossible in ordinary electric lighting stations worked under municipal conditions (*i.e.*, limited in size by the size of the town whose needs they supply) to offer the supply of power during the day time at rates below 1d. per unit on a sound financial basis, except subject to certain restrictions.

Referring to the motors typified under cases Nos. 1 and 2, it will be seen that, apart from interest charges, the respective costs would be only 0·88d. and 1·20d. per unit. If a station of the above class were to start charging rates as low as these, the regulation amounts for interest and sinking fund and the usual "net profits" would still be maintained for the first few years, and a fine motor business would be built up. After the fourth or fifth year, however, "extensions" in plant and mains would begin to be required very rapidly, and the price for motive power would then have to be raised. The safer course is to be found in offering these rates subject to such stipulations as shall protect the scheme from financial unsoundness.

Briefly the stipulation to be made is that the consumer shall enter into an agreement to take no current for motive power purposes between certain hours during the winter months, in return for these extremely low rates, subject to the penalty of being put on a two-rate meter combined with a time-switch in the event of the offence being persisted in. The hours at which current would be cut off would be as follows:—September, 5.30 p.m.; October, 4.30 p.m.; November, 3.30 p.m.; December, 3.0 p.m.; January, 3.30 p.m.; February, 4.30 p.m.; March, 5.30 p.m.

There can be no risk, when offering these conditions, of the station being swamped with a motor load which might exceed even its "midday" capacity; and the station must, at least, better its present motor load, for it is inconceivable that, in any industrial town of moderate size, there shall not be some consumers who can afford to have their power cut off at certain hours in the winter.

Limit of Station Plant Dependent on Day Fogs.—In most large towns it will be found that the worst day fog never gives a demand, for lighting alone, greater than 66 per cent. of the worst "peak" of the following December. In fig. 1 this is taken as a basis, and it is found that 1,700 KW. of motor load, representing about 5,500,000 units per annum, can be added to the output of a station whose initial "peak" is only 1,800 KW., before the limit of the capacity of the plant to deal with a day fog is reached. This assumes a 60 per cent. motor load, and 10 per cent. lighting load, development annually for five years. If such an extremely rapid motor load should not be realised, the period of development will be longer before the limit is reached.

Fig. 2 shows the same principle applied to a lighting load which refuses to be developed. Here the limit is reached in four years. The annual motor units thus added are in this case only 3,360,000, and the KW. are 1,060.

Reduction in Works Cost to secure "Non-Interest-Paying" Motor Load. —Hitherto, in this paper, it has been assumed that it is correct to charge the motor load with the full present value of the "Works Cost." Such a course, however, the author believes to be quite unnecessary. The charge on account of wages in stations of about 2,000-KW. capacity, is frequently of the order of 0·2d. per unit, especially where there is no traction load. This might be reduced to 0·05d. per unit. A figure frequently obtained for the item of repairs is 0·2d. per unit; let us then take 0·10d. per unit. Oil and stores we may put at 0·05d. per unit.

If the station had been costing 0·45d. per unit for coal with the lighting load alone, we could assess the coal item at 0·3d. for the motor load.

We thus have: Wages = 0·05d.; repairs = 0·10d.; oil and stores, = 0·05d.; coal = 0·3d. Total works cost = 0·5d.

Add to this: Office expenses = ·10d.; rates, rent, taxes = ·05d; net profit, ·15d.; and we have: Total charge to (non-interest paying) consumer = 0·5d. + ·30d. = 0·80d. *per unit.*

General "Stand-by Loss" Diagram.—It is likely that most engineers responsible for the running of stations, have felt that if the whole of the losses which occur in the station and sub-stations, from the putting in of the coal into the boilers to the delivery of current to the bus-bars, could be added together graphically, and if the relative effect which each has upon the general efficiency of the station under the varying conditions of load could be so shown, we should have a guide which, if adhered to, would materially improve the coal consumption account in many stations in this country.

The diagram shown in fig. 3 is an attempt to represent the hourly rate of burning coal in terms of the kilowatts of output of that part of the load-curve of the station which may be under consideration.

The principle of the diagram is as follows:—Starting with D.C. kilowatts at bus-bars, plot a curve connecting this with I.H.P., and a little below this curve plot another curve, nearly parallel to it, connecting kilowatts with E.H.P. The space enclosed between these two curves will then obviously represent the combined electrical and mechanical losses of the generator for different proportions of its load.

Next, use the I.H.P. scale as the scale of abscissæ, and for the scale of ordinates take pounds of steam delivered by the boiler per hour to the main steam range. Plot first a curve connecting steam consumed by the engine with I.H.P.; then draw above this (in fig. 3 it is shown at foot) a line representing excess steam necessary on account of steam feed-pumps, then a line above this (also shown at foot in fig. 3) representing condensation losses in steam pipes to boiler and engine and in main steam range, then again a line above this representing steam consumed by the air and circulating pump engines.

Lastly, take the scale of steam per hour and use it as a scale of abscissæ and set off a scale of pounds of coal per hour as ordinates, and draw a curve connecting these. To settle what scale to employ for the total pounds of coal per hour, we must first decide what evaporation to allow per pound of coal at full load of the boiler.

The author has taken a figure of 7·68 lb. for feed, as received from economiser, to pressure at, say, 160 lb.; but this is a figure which each engineer must determine for himself, as it of course depends on the coal used and the economiser and boiler efficiency.

We now have a combination of three diagrams, and starting with any output in kilowatts, we can readily trace round through the three diagrams to the coal consumption per hour. We can also see the exact effect of "stand-by losses" in engines, dynamos, pipework condensers, feed-pumps, boilers, &c.

The diagram is constructed for a station equipped with eight B. & W. boilers, three 600-KW. and two 300-KW. steam dynamos and four 600-KW. condensers.

Suppose, now, that we had no battery in the station, and that, at a certain hour of the night, we had only a few amperes leaving the station—fortunately an unpractical condition—requiring, however, that at least one boiler be kept under full steam and one dynamo maintaining bus-bar pressure, we find from the diagram that the stand-by losses are:—I.H.P. = 120; steam per hour = 6,000 lb.; coal per hour = 900 lb. This is for a B. & W. boiler and an engine of 375 KW., triple expansion, by W. H. Allen & Co.

The author does not put forward any of the figures in Diagram 3 as final. He suggests that each station engineer may construct diagrams to suit his own plant, and obtain from the engine, boiler and pump makers, curves for the apparatus they supply. If he then combines these and finds that the pounds of coal per hour, taken for any convenient part of his load curve whatsoever, differs *radically* from that which he is really burning, he will be justified in commencing a search to know the reason why. It is here that the diagram will help him.

(To be concluded.)

ELECTRIC DRIVING OF TEXTILE MILLS.

By W. B. WOODHOUSE, Assoc. Member.

(*Abstract of Paper read at Leeds, December 15th, 1904.*)

THE object of this paper is to state, briefly, the advantages of electrical driving. On the Continent electric driving is largely used in the woollen, cotton, and silk industries; in the United States, at the census of 1900, over 140,000 H.P. of electrical machinery was in use in cotton mills alone, and a considerable proportion are supplied with current from public mains.

The preparation of animal or vegetable fibres involves a very large number of operations, and, owing to the delicate structure of the fibre the amount of work done on it in each machine is small; it is therefore readily understood that the power required to drive the machines unloaded is a large percentage of the total required.

Mechanical transmission of power from a main engine to the various machines by means of ropes, belts, gearing and shafting, involves a steady loss of power which is very little reduced by the stoppage of individual machines. In a number of mills which the writer has tested, the average efficiency at full load is 50 per cent., the lowest 34 per cent, and the highest 70 per cent., in all these cases the loss of power in the main engine being included; these losses, serious enough at full load, are practically constant, and so the efficiency rapidly decreases as the load becomes less.

It will be convenient to speak of the ratio of the average power required to the maximum required during working hours, as the working load factor. When the source of supply is electrical, this is equal to $\frac{\text{units consumed}}{\text{maximum demand in KW.} \times \text{working hours}}$.

Fig. 1 is an actual record showing how the load varies through the day in a flax mill of the British Linen Thread Co. The mill is electrically-driven and the transmission loss small. The maximum power demanded is 285 KW. and the average 259 KW., giving a working load factor of 91 per cent. Had the various machines been driven by mechanical transmission from one main engine, a steady extra loss would have been incurred, on account of the friction of extra shafting and gearing; assume this as only 20 per cent. of full load, then the maximum power would be raised to 342 KW., and the load factor increased to 92·5 per cent. That is to say, the more inefficient the system of power transmission in a mill, the steadier is the load on the main engine.

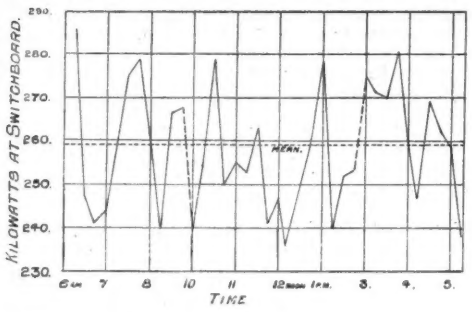


FIG. 1.—GENERATOR LOAD CURVE OF A FLAX MILL.

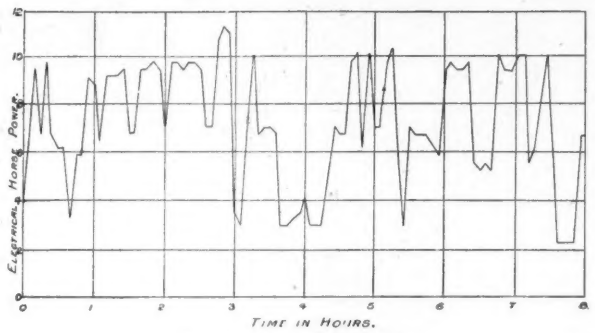


FIG. 3.—MILLING SHED LOAD.

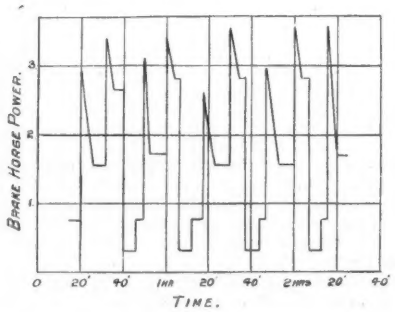


FIG. 2.—VARIATION OF LOAD.—SELF-ACTING MULE WITH 120 SPINDLES.

In a large cotton mill, variations of load were noted from 1,575 H.P. to 1,685 H.P.

Mill owners usually reckon their costs in pounds per I.H.P. per annum, and the figure is usually based on the maximum H.P. indicated; it is not possible to compare such a figure with the cost of electrically driving the same mill without knowing the electrical or B.H.P. taken to drive each machine, or group of machines, and the working load factor of the machines.

For each particular class of machines there are peculiarities of working which determine the working load-factor; such as: frequent stops of short duration, in the case of looms; a periodical stoppage of part of the machine, as in spinning; intermittent running, with long stops, as in milling or printing machines. A particularly irregular load is met with in the case of self-acting mules. Fig. 2 shows the power taken by a mule as it goes through the various operations of drawing, twisting, backing off, and winding on. The working load factor is 46 per cent. on one machine.

When a group of mules are driven from one motor a heavy flywheel on the motor tends to steady the demand for current; despite this, however, the fluctuation of load is more extreme than in the main engine of a mechanically driven mill.

The maximum power taken by a motor driving four self-acting cotton mules was 32 B.H.P., and the average 19 B.H.P., or a working load factor of 59 per cent.

The amount of power taken by machines having many bearings steadily decreases as the bearings and the oil warm up. A worsted spinning frame, with two different qualities of spindle oil, showed a difference of nearly 5 per cent. in power consumed.

The milling or fulling of woollen cloths is a process in which the power required varies from piece to piece, depending on the amount of milling required; the working load factor is very low. Fig. 3 is an actual record of a day's work of milling and washing machines; the working load factor is only 63 per cent.

Tests made on carding machines show a fairly steady load during the time of running (fig. 4). Rag-grinding machines often show a considerable variation, depending on the material they are being fed with. Fig. 5 is the load curve of two balling boxes, which are, normally, being repeatedly started and stopped.

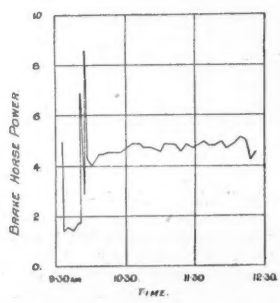


FIG. 4.—SCRIBBLER, INTERMEDIATE AND CARDER. 65 R.P.M.

There is a lack of information as to the power taken by textile machines; the particulars of some tests are given below.

Spinning.—Motor driving 38 ring spinning frames of 10,032 spindles, running at 9,000 r.p.m., spinning No. 35 cotton yarn.

Number of frames running ...	38	28	18	8
Power in kilowatts	140	107	76	44
Spindles per kilowatt	81·2	83·8	82·5	78·2

or an average of 62 spindles per E.H.P.

Worsted spinning frame of 200 spindles, running at 5,800 r.p.m.:—

1st test—Average B.H.P. ... ... 4·45
2nd „ „ ... ... 4·19

The difference, as explained above, being due to the quality of oil used.

Self-Acting Mules—Cotton.—Motor driving line shaft and four mules:—

Mules running.	Spindles. Number.	r.p.m.	Max. H.P.	Average H.P.
All	2,712	—	32	19
No. 1 only ...	672	7,600	20	13
No. 2 „ ...	672	7,600	18	9
No. 3 or 4 ...	684	7,800	15	9

The spindle friction and windage varies directly as the speed.

Roving Boxes.—*Worsted*—Dimensions of bobbins, 6 in. × 3 in.; number of spindles, 12; r.p.m., 1,000; B.H.P., 0·4.

Weaving.—The amount of power taken by looms varies with the class of work and dimensions of the looms.

	Power taken.
Silk Looms—Small loom	0·25 B.H.P.
Jacquard	0·5 ,,
Cotton Looms—Draper loom, 160 picks per min.,	0·25 ,,
Woollen Looms—Various	0·3 to 0·5 B.H.P.

Carding Machines:—Woollen, carding Botany, 48 in. swift, power at starting, 7 E.H.P.; running, average, 3·2 E.H.P. 60 in. swift, running at 96 r.p.m., average power, 5 E.H.P.

Scouring Machine.—The following figures, of relative power taken, are from a test of one machine:—Maximum running H.P., 100 per cent.; when changing liquor, 38 per cent; working load factor, 86 per cent. The changing and heating of liquor reduces this to about 70 per cent.

Milling Woollen Cloths—Motor driving milling machine, washing machine and mangle:—Maximum E.H.P., 11; working load factor, 63 per cent.

The amount of power taken in milling varies from day to day.

The effect of electrical driving on the general arrangement of a mill is to allow the various machines to be arranged in the natural order of the processes without reference to the position or direction of shafting. The sub-division of the driving may be carried to its

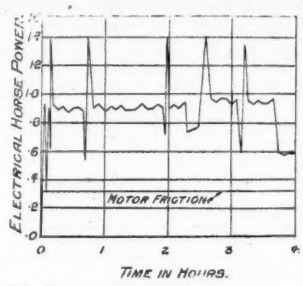


FIG. 5.—SINGLE AND DOUBLE-HEAD BALLING BOXES.

full extent; it has found its most successful application in the driving of silk looms, the valuable material worked on, making the risk of damage from oil or dirt thrown from a shaft or belt a serious one. The motors, rated at ⅓ H.P., either drive the looms by gearing or by a single belt, and, to enable the tension of the belt to be adjusted the motor is swung on an arm and supported by springs; the weight of the motor tends to keep the belt tight, and the tension may be adjusted at will. Such extreme sub-division is, however, rarely advisable, on account of first cost, and group driving must be nearly always adopted. A considerable saving on the cost of equipment can be effected by increasing the speed of the line shafts, and thereby reducing the size of shafts, pulleys and hangers. Certain machines have their driving shafts running at a sufficiently high speed to be direct coupled to a motor.

Group driving of from two to four machines without line shafting may be accomplished by fitting the motor with two pulleys, one at each end of the motor.

A word of warning may be given as to the installation of motors too large for their work, on account of the lessened efficiency and increased cost. The continuous rating of the motor should correspond with the average load.

In the majority of textile operations constant speed is of vital importance; the output of a mill depends on the maximum speed at which the thread can be safely run, and any variation below this, results in a decreased output. Regularity of speed at the machines in a "mechanical" mill is never obtained. In one case the speed on the front rolls in one room varied from 103 to 120 r.p.m. A direct connected motor showed a range of speed of from 120 to 122.

The provision of any speed regulation on motors driving the large majority of textile machines is unnecessary. This necessity of constant speed, points clearly to the use of polyphase motors in preference to direct current machines, and for this work the advantages of squirrel-cage motors are many.

With a direct-current equipment more attention is required, and the motor must be completely enclosed. The great objection is, however, the variation of speed, at different loads and temperatures. In a case brought before the writer's notice, where shunt motors were used, the complaint was made that on Monday mornings the machinery ran slow, with a consequent reduction of the output of the mill, and the same fault was noticed in a less degree on other mornings; this was due to the field windings being cold, and, to some extent, to the extra stiffness of the machinery. The polyphase induction motor under similar conditions would vary in speed by an inappreciable amount.

The only important class of variable speed machines is found in textile printing. Multi-voltage direct-current systems, with shunt motors, have much to recommend them in the case of isolated plants, but excellent results have been obtained by the use of a single-supply voltage, and motors with double-wound armatures and two commutators. In the latter case a high efficiency is obtained over a wide range of speed.

The centrifugal machine direct coupled and electrically driven is compact, simple, and reliable, and can be placed anywhere. Either series D.C. or induction motors may be used for this work; the induction motor has an important advantage in that it can never "run away." In practice the motor is completely enclosed, and flexibly supported beneath the basket. The time taken to accelerate depends on the maximum torque of the motor at various speeds. Hence, if a squirrel-cage motor is adopted, it should be built with a high-resistance rotor, so that the current may be kept down during acceleration. The time taken to accelerate is then practically constant, and the machine needs no attention beyond switching on the motor, which runs up to speed and stays there until switched off. The following table gives the power required for two standard makes of machine:—

Power Required to Drive Centrifugals.

	POTT, CASSEL'S & WILLIAMSON TYPE.					BROADBENT & SONS' TYPE.			
				Watts.		Watts.		Time to	
Dia. of basket.	Units per hour.	Revs. per minute.	Time to accele-rate.	Start-ing.	Run-ning.	Start-ing.	Run-ning.	accele-rate.	Max. speed.
24″	0·75	1,500	0·75′	2,530	690	—	—	—	—
30″	1·02	1,200	1·0′	3,100	1,260	5,400	2,700	1·5′	1,100
36″	1·28	1,000	1·5′	3,200	1,370	5,800	2,900	1·5′	1,000
42″	—	—	—	—	—	6,400	3,200	1·5′	950
48″	3·19	750	2·5′	5,950	2,070	7,200	3,600	1·5′	900
54″	—	—	—	—	—	8,400	4,200	1·5′	800
60″	—	—	—	—	—	10,000	5,000	1·5′	700
72″	—	—	—	—	—	17,600	8,800	1·5′	600

The matching of colour can only be done satisfactorily by sun or arc light. The use of enclosed arc lamps in mills, gives excellent results for general illumination; for local lighting the incandescent lamp has the great merit of safety. The greater purity of the air, due to the absence of gas, also has an important effect on the health of the workers.

Electrical heating of the mill is not out of the question, and electrically-driven fans for ventilating and removing dust; these are finding extended application as a means of transporting wool from the washing machines to the carders, by way of an air-shute connecting the rooms.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

28,329. "An improvement in or connected with the working of telephonic systems." R. L. MURRAY and F. J. JACKSON. December 27th. (Complete.)

28,336. "Improvements in brush-holders for dynamo-electric machines and other uses." VERITYS, LTD., and D. E. ROGERS. December 27th.

28,345. "Improvements in regulating gear for use in connection with train lighting and similar dynamos." C. D. CHARLESWORTH and J. R. CHARLESWORTH. December 27th.

28,350. "A new or improved attachment or appliance for use in connection with suspended electric lamps." E. A. J. HOOPER. December 27th. (Complete.)

28,369. "Improvements in electric switches." G. HARRISON. (M. Guett, United States.) December 27th. (Complete.)

28,370. "Improvements in electric switches." G. HARRISON. (M. Guett, United States.) December 27th. (Complete.)

28,375. "Electric bipolar plates accumulator." G. M. ZINGEL. December 27th.

28,393. "Improvements in or relating to electric current governers." A. J. BOULT. (W. J. Richards, United States.) December 27th. (Complete.)

28,409. "Electric arc lamp." W. FAIRWEATHER. (The Marquette Electric Co., United States.) December 27th. (Complete.)

28,416. "Appliance for the commutation of current in armatures of dynamos." E. ARNOLD and J. L. LA COUR. December 27th. (Complete.)

28,453. "Improved continuous-current electric motor." SOC. ANON POUR LE TRAVAIL ELECTRIQUE DES METAUX. (Date applied for under Patents Act, 1901, May 10th, 1904, being date of application in France.) December 27th. (Complete.)

28,455. "Improvements in central telephone station installations." SIEMENS BROS. & CO., LTD. (Siemens and Halske Aktien-Gesellschaft, Germany.) December 27th. (Complete.)

28,458. "Incandescent electric lamp." F. W. HOWORTH. (J. H. Guest and C. I. Hills, United States.) December 27th.

28,467. "Improvements in or relating to electric incandescence lamps." W. P. THOMPSON. (Deutsche Gasglühlicht Act.-Ges. (Auer. Ges.), Germany.) December 27th. (Complete.)

28,468. "Improvements in systems of electrical conductors." B. GATI. December 27th. (Complete.)

28,471. "Combined starting and braking device for electric motors." A. HULTQVIST. December 27th. (Complete.)

28,495. "Improvements in or relating to automatic electric switches." A. FIRLEY. December 27th.

28,522. "Improvements in electric signalling on railways." W. J. MACKENZIE. December 28th.

28,525. "Improvements in trolley standards for electric tramcars and the like." M. B. MOUNTAIN and G. M. GIBSON. December 28th.

28,546. "Improvements in protected or armour-clad switch-fuses." H. H. BERRY. December 28th.

28,554. "Improvements in or relating to thermo-electric couples." A. J. BOULT. (W. Hoskins, United States.) December 28th. (Complete.)

28,601. "Improvements in apparatus for electro-deposition of metals." W. R. KING. December 28th. (Complete.)

28,608. "Improvements in and relating to 'electric candle' lamps." C. C. REGNART and the HUNTER ELECTRIC CANDLE LAMP CO., LTD. December 28th. (Complete.)

28,618. "Improvements in motor-starting switches." MAVOR & COULSON, LTD. and H. A. MAVOR. December 28th.

28,629. "Improvements relating to drop signals or annunciators for central telephone stations and so forth." I. B. BIRNBAUM. December 28th.

28,677. "Improved safety device for electric railways." F. OWEN. December 29th.

28,678. "Improvements in, or applicable to, cranes and other lifting machinery driven by electric motors." F. W. REED and CRAVEN BROS., LTD. December 29th.

28,687. "Improvements in means or apparatus for automatically starting, controlling and stopping single or multiphase alternating current electric motors." O. CARR and J. C. BIRCH. December 29th.

28,704. "Improvements in electric massage apparatus." L. KUBITZ. December 29th. (Complete.)

28,714. "A new electro-plated silk hat ironer." J. O'NEILL. December 29th.

28,717. "Improved operating gear for groups of electrical switches and rheostats." W. DEFRIES. December 29th.

28,722. "Improvements in, or relating to, electric incandescent lighting devices." C. SCHWABE. December 29th. (Complete.)

28,723. "Improvements in electric incandescent lighting devices for shop windows, show cases and the like." C. SCHWABE. December 29th. (Complete.)

28,734. "Improvements in electric incandescent lighting devices for billiard tables, exhibition tables, sale counters and the like." C. SCHWABE. December 29th. (Complete.)

28,749. "Improvements in or relating to telephones for the use more particularly of divers." E. C. LACEY and J. HOLMAN. December 29th.

28,787. "Improvements in electrical switches." G. B. STERN and A. C. GREENE. December 29th.

28,791. "Improvements in electric current distributors for luminous letters." L. SNOECK. December 29th.

28,797. "Apparatus for indicating the number of a telephone subscriber." A. M. ANDERSEN. (Date applied for under Patents Act, 1901, March 30th, 1904, being date of application in Denmark.) December 29th. (Complete.)

28,804. "Improvements in and relating to insulators for high-voltage electric lines." SOCIETA CERAMICA RICHARD-GINORI. (Date applied for under Patents Act, 1901, June 22nd, 1904, being date of application in Italy.) December 28th. (Complete.)

28,824. "Improvements in electric igniting arrangements for internal combustion engines." L. RENAULT. (Date applied for under Patents Act, 1901, February 2nd, 1904, being date of application in France.) December 29th. (Complete.)

28,826. "Improvements in or connected with space telegraphy." J. S. STONE. (Date applied for under Patents Act, 1901, February 18th, 1903, being date of application in United States.) December 29th. (Complete.)

28,827. "Improvements in or connected with bolometers and space telegraphy." J. S. STONE. (Date applied for under Patents Act, 1901, February 15th, 1904, being date of application in United States.) December 29th. (Complete.)

28,840. "A self-acting motor starting rheostat." J. A. HIRST and P. S. BROOK. December 30th.

28,845. "Improvements in anti-vibration electric couplings." R. W. BILL and S. BILL. December 30th.

28,852. "An improved conduit for containing electric cables and wires, and other wires, tubes, pipes and the like." W. HEPWORTH-COLLINS. December 30th. (Complete.)

28,858. "An improved electric switch and circuit-breaker." J. A. HIRST and P. S. BROOK. December 30th.

28,875. "Plug adaptor for electric lamps." W. F. SIMMONDS. December 30th. (Complete.)

28,889. "Improvements in or relating to electric control circuits with heat indicators." M. A. ABRAHAMSON. December 30th.

28,895. "Electric lamp for ovens." W. E. G. READ. December 30th.

28,899. "Improvements in electric bell pushes." W. WALKER, junr. December 30th.

28,968. "Improvements in series commutator motors for single-phase alternating current." THE MASCHINENFABRIK OERLIKON. December 30th. (Date applied for under Patents Acts, 1901, February 29th, 1904, being date of application in Switzerland.) (Complete.)

28,985. "An improvement in and relating to revolving hair brushes actuated by electric currents." C. P. J. FITZSIMON. December 30th.

29,001. "Improvements in or relating to electric railway conduit systems." J. VAN AERSCHOT. December 30th. (Complete.)

29,004. "Improvements in or relating to electric railways and tramways." C. MACKINTOSH. December 30th.

29,014. "Improvements in electric switches." R. LONGDEN. December 30th.

29,015. "Improvements relating to the automatic control of overloads in electric circuits." SIEMENS BROS. & CO., LTD., and P. G. LEDGER. December 30th.

29,054. "Improvements in electric incandescent lighting devices for pictures, music desks, writing desks, pianofortes and the like." C. SCHWABE. December 30th. (Complete.)

29,057. "Improvements in electric insulation." M. MEIROWSKY. December 30th.

29,058. "Improvements in terminals for electric conductors." L. RENAULT. (Date applied for under Patents Act, 1901, May 2nd, 1904, being date of application in France.) December 30th. (Complete.)

29,059. "Improvements in electric ignition plugs for internal combustion engines." L. RENAULT. (Date applied for under Patents Act, 1901, May 2nd, 1904, being date of application in France.) December 30th. (Complete.)

29,068. "Improvements in, or connected with, insulators of overhead electric conductors." E. GIRAUD. (Date applied for under Patents Act, 1901, April 14th, 1904, being date of application in France.) December 30th. (Complete.)

29,065. "Improvements in electric dry batteries." H. W. BUTLER. December 30th.

29,064. "Improvements in safety devices for overhead electric conductors." E. GIRAUD. (Date applied for under Patents Act, 1901, April 14th, 1904, being date of application in France.) December 30th. (Complete.)

29,079. "Improvements in electric current measuring and recording apparatus." G. G. M. HARDINGHAM. (V. Arcioni, Italy.) December 30th.

29,107. "Improvements in telephones for diving and like purposes." R. H. DAVIS and A. GRAHAM. December 30th.

29,118. "Improvements in insulator supports." E. H. FAIRBANKS. December 30th. (Complete.)

29,125. "Improvements relating to switching devices for electric lamps especially adapted for use in 'flash' advertising." L. KINGWILL. December 30th.

29,126. "Improvements in apparatus for switching on and off lamps, especially applicable for use in 'flash' advertising." L. KINGWILL. December 30th.

29,129. "Improvements in and relating to electro-magnetic separators." W. BLACKMORE. December 30th.

29,142. "Improvements in space telegraphy." J. S. STONE. (Date applied for under Patents Act, 1901, February 23rd, 1904, being date of application in United States.) December 30th. (Complete.)

29,143. "Improvements in or connected with space telegraphic receiving systems." J. S. STONE. (Date applied for under Patents Act, 1901, February 23rd, 1904, being date of application in United States.) December 30th. (Complete.)

29,144. "Improvements in space telegraph systems." J. S. STONE. (Date applied for under Patents Act, 1901, April 11th, 1904, being date of application in United States.) December 30th. (Complete.)

29,145. "Improvements in space telegraphy." J. S. T. (Date applied for under Patents Act, 1901, April 11th, 1903, being date of application in United States.) December 30th. (Complete.)

29,146. "A new or improved support for use in space telegraphy." J. S. STONE. (Date applied for under Patents Act, 1901, May 3rd, 1904, being date of application in United States.) December 30th. (Complete.)

29,187. "Improvements in electric igniters for explosion motors." H. GUILLOU. (Date applied for under Patents Act, 1901, January 2nd, 1904, being date of application in France.) December 31st. (Complete.)

29,233. "Improvements in or connected with low-tension electric ignition devices for internal combustion motors." ALBION MOTOR-CAR CO., LTD., and T. B. MURRAY. December 31st. (Complete.)

29,259. "Charging plug and leads for charging an accumulator from the lamp-holder on any direct current electric lighting circuit." E. P. M. ELDRIDGE. December 31st.

29,281. "Improvements in apparatus for opening and closing electric circuits at pre-determined times." J. GUNNING. December 31st.

29,307. "Improvements in or relating to switches for electric incandescent lamps." A. FREY. December 31st. (Complete.)

29,308. "Improvements in or relating to the detection and recording of electrical impulses or oscillations and apparatus therefor." G. F. ANDERSON. December 31st.

29,310. "Improvements in or relating to electrical dumb-bells and similar appliances for physical exercises." A. LEOBL. December 31st. (Complete.)

29,337. "Method of and means for the protection of electrical apparatus branched on circuits which are traversed (accidently or otherwise) by currents of high frequency." G. E. GAIFFE. December 31st.

29,343. "Improvements in or connected with electrical gas-igniting and extinguishing apparatus." H. L. DOWN and D. H. WISEMAN. December 31st.

29,345. "Improvements in or connected with electrical gas-igniting and extinguishing apparatus." H. L. DOWN and D. H. WISEMAN. December 31st.

29,346. "Improvements in or connected with electrical gas-igniting and extinguishing apparatus." H. L. DOWN and D. H. WISEMAN. December 31st.

29,347. "An improved electric transformer." G. STERN. December 31st. (Complete.)

29,349. "Improvements in insulating coverings." C. BRADER. December 31st.

29,353. "Improvements in rotary converters for electric currents." L. J. HUNT and THE SANDYCROFT FOUNDRY CO., LTD. December 31st.

29,354. "Improvements in apparatus for transmitting electric signals or impulses." G. GRABOSCH. December 31st.

29,363. "Improvements in and relating to electrical measuring instruments." H. H. LAKE. (V. Arcioni, Italy.) December 31st. (Complete.)

29,368. "Improvements in and connected with induction coils." H. W. SULLIVAN. December 31st.

29,369. "Improvements in and connected with electric relays and recorders." H. W. SULLIVAN. December 31st.

29,377. "Improvements in fuses for electrical circuits." M. B. FIELD and FERRANTI, LTD. December 31st.

29,397. "Improvements in and relating to pendant electric fixtures." H. H. LAKE. (W. Lincoln, Bradshaw, A. Keough, M. Keough and J. Keough, United States.) December 31st. (Complete.)

29,406. "Improvements in current distributors for the electric ignition devices of internal combustion engines." L. RENAULT. (Date applied for under Patents Act, 1901, September 23rd, 1904, being date of application in France.) December 31st. (Complete.)

29,422. "Improvements relating to electrical apparatus for transmitting and receiving signals." A. T. DAWSON and G. T. BUCKHAM. December 31st.

29,428. "Improvements in automatic photographing telegraphs." P. RIBBE. December 31st. (Complete.)

29,429. "Improvements in synchronising systems." P. RIBBE. December 31st. (Complete.)

29,435. "Improvements in alternating current collector motors." SIEMENS BROS. & CO., LTD. (Siemens-Schuckert Werke, Germany.) December 31st.

29,436. "Improvements in alternating current collector motors." SIEMENS BROS. & CO., LTD. (The Siemens-Schuckert Werke, Germany.) December 31st.

29,437. "Improvements in electrical ignition devices for internal combustion engines and other purposes." J. A. TORRENS. December 31st.

29,438. "Improvements in electrical measuring instruments." J. H. GRAY. December 31st.

29,449. "Improvements in and relating to arc lamps." O. KONITZER. December 31st.

29,468. "Apparatus or appliance for supporting a telephonic receiver and transmitter or analogous instrument." W. H. DANSON. December 31st.

29,487. "Improvements in or relating to space telegraphy and apparatus therefor." G. F. ANDERSON. December 31st.

29,516. "A new or improved automatic circuit breaker or cut-out for overhead tramway systems." H. G. TURNELL. December 31st.

29,529. "Improvements in telephone systems." F. VOLLMER. December 31st.

29,538. "An improved electric circuit-closer for fire alarms." J. E. BEMILLER and E. C. WEISENSALE. (Date applied for under Patents Act, 1901, May 7th, 1904, being date of application in United States.) December 31st. (Complete.)

29,607. "Improvements in liquid resistances for controlling the current in electro-motors and the like." BRUCE PEEBLES & CO., LTD., and A. C. PEEBLES. December 31st.

29,613. "Improvements in electrolytic meters." G. HOOKHAM. December 31st.

29,645. "Improvements in telephone and like plug cords." W. G. INGLEFIELD. December 31st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

ELECTRIC LAMP AND SOCKET. A. N. Soden. 6,496. March 17th.

SYSTEM OF ELECTRIC LIGHTING ESPECIALLY INTENDED FOR USE ON ROAD VEHICLES. C. P. Tolman. 6,523. March 17th. (Date claimed for patent July 30th, 1903.)

SECONDARY ELECTRIC BATTERIES. E. Commelin and R. Viau. 6,619. March 18th. (Date claimed for patent March 18th, 1903.)

ELECTRICAL CONDUCTORS AND COILS. J. C. Anderson. 6,678. March 19th. (Date claimed for patent April 30th, 1903.)

FUSES FOR ELECTRIC BLASTING. F. Render. 6,679. March 19th.

ELECTRIC SWITCHES. A. H. Babcock. 6,716. March 19th. (Date claimed for patent March 23rd, 1903.)

ELECTRICITY METERS FOR ALTERNATING CURRENTS. H. Aron. 6,724. March 19th.

ELECTRO-MECHANICAL CUT-OUTS. J. E. Spagnoletti. 6,833. March 21st.

AUTOMATICALLY CONTROLLING THE PASSAGE OF ELECTRIC CURRENTS. J. E. Spagnoletti. 6,834. March 21st.

TERMINAL ATTACHMENT FOR THE CONDUCTING WIRES OF ELECTRICAL MACHINES AND APPARATUS. A. Sauser. 6,843. March 21st.

ELECTRICAL DISTRIBUTION. J. L. Wocdbridge. 6,859. March 22nd.

ELECTRIC CABLE COUPLINGS. F. Everhart and J. J. Dossart. 7,012. March 23rd.

TELEGRAPHIC SIGNAL SYSTEMS. C. G. Burke. 7,129. March 24th.

CONTROLLING SYSTEMS FOR ELECTRIC MOTORS. G. Westinghouse and L. M. Aspinwall. 7,208. March 25th. (Date claimed for patent May 1st, 1903.)

IMPLOVEMENTS IN MULTI-VOLTAGE ELECTRIC GENERATORS. G. H. Gibson. 7,209. March 25th. (Date claimed for patent April 4th, 1903.